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CANCER OF THE STOMACH[1]

(CARMAN LECTURE)

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THERE are three reasons this evening for my great pleasure and enthusiasm: Dr. Carman was my personal friend and colleague for many years, Roentgen was an idol of my boyhood, and cancer of the stomach has been one of the main subjects of my scientific and clinical investigation for more than thirty years.

When I was a second-year medical student at Johns Hopkins University Dr. Carman joined my class as a graduate student; our work tables in pathology and bacteriology were side by side. From 1902 until 1912, when he became associated with our clinic, I lost intimate touch with him but it was during that period that he was building the foundations upon which his later fame rests. It was then that he began his contributions to roentgenologic literature by reporting his studies of pulmonary tuberculosis, foreign bodies of the eye, orbit, and other regions of the body. To these studies were added some contributions to our roentgenologic knowledge of osteo-arthropathies and thoracic aneurysms. It was not until 1913 that he published his first articles on gastric roentgenology. These followed soon after the observations of Groedel (1912) and Forssell (1913) upon gastric structure and motility. It was also after Holzknecht (1911) and Haudek (1912) reported their observations. From 1912 to the time of Dr. Carman's death in 1926, he and I made daily comparative studies of his roentgenologic observations and my studies of resected gastric and duodenal lesions.

The second reason for my pleasure this evening rests in my experience as one of the first x-ray observers in the world. This may seem strange to you who know that I am not a roentgenologist. In 1896, just a few weeks after Roentgen made his discovery in 1895, I had the privilege of repeating his experiments, being then a very young student playing with Crookes' tubes in one of the best equipped laboratories of physics in this country. Knowing that I was later to study medicine and having some knowledge of anatomy, I appreciated the possibilities of these rays for medical diagnosis. Still maintaining a suspicion of its future value and being interested in gastric cancer, I went to Europe to see Holzknecht and Haudek in 1913. It was on this trip that I first had the opportunity of seeing, hearing, and meeting Roentgen who had been one of my idols since I was fifteen years of age. You may well appreciate how I feel in paying tribute to my good friend and co-worker, Russell Carman, and Professor Roentgen, an idol of my youth.

[1] Read before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Penna., Nov. 29, 1938.

Naturally, the third reason lies in my years of interest in gastric cancer. The story of our present knowledge is a long one. It has evolved in stages, each dependent upon a new opportunity to study this subject. If historical records be correct, it began with the observations of Morgagni (1761), and continued with those of Baillie (1793), Abercrombie (1824), von Rokitansky (1842), Hauser (1883), and Welch (1885). All of these observers dealt with autopsy material which reveals only the final stages of disease.

I believe it is fair to state that the best anatomical study of postmortem material during those early years was that of Hauser (1883) and the best statistical study was made by Welch in 1885. I suspect that the autopsy room will never reveal more about gastric cancer, its origin, its histogenesis, and relative frequency than those two observers saw over half a century ago. Postmortem material does not lend itself to cytological study and early cancers rarely, if ever, are seen at autopsy. When they are seen immediate ante mortem and postmortem changes have altered the picture as we now know it in living tissues.

The new opportunity for observation with which I have been personally concerned followed the development of operative abdominal surgery which also has a long history. It must be understood clearly that Pasteur's work in bacteriology and the development of anesthesia did not evolve over night. Both of these had to reach a certain maturity before any surgeon dared explore the abdomen. In 1881 Billroth, who was extremely slow in accepting Lister's work which was based upon that of Pasteur, did his first successful gastric resection. In 1881 Wölfler made his first successful gastro-enterostomy. It was seven years later when Maydl (1888) made the first successful colostomy and not until nine years later (1890) that Halsted introduced the use of rubber gloves.

It was at the very beginning of the twentieth century that gastric surgical technic really became generally standardized and fairly successful. Even then, the surgeon had little opportunity to apply what he knew and could do. Medical authorities required proof that surgery offered more than they could give. Their reticence was not unwarranted as may be seen from the observations of Osler, who, in 1894, reported his clinical experience with abdominal tumors. In his series he reported 24 cancers of the stomach, all of which were advanced cases—only one was submitted to surgery and the patient died. The surgical risk was very great and clinicians were not recognizing cancer except in its latest stages. There were no x-rays in 1894 and—for gastric diagnosis—not until about twenty years later.

In 1897, W. J. Mayo stated in a paper on the general status of gastric surgery that he found the mortality in gastro-enterostomy to be about 50 per cent with the suture method, and 23 per cent with the button method which had been described by Murphy in 1892. Thus it may be seen that the medical profession reached the twentieth century before it began to have an opportunity actually to see gastric cancer before the patient died. In 1900, W. J. Mayo reported 23 gastric operations for malignancy, with an improved mortality of 17.5 per cent. Others were doing no better.

In 1900, Osler and McCrae again reported their clinical experience. There were 150 gastric cancers, all in the late stages of disease. Only nine of these were operated upon by their colleagues, Halsted and Finney. Six were inoperable, one patient had a gastro-enterostomy and died, one had a gastrostomy and died, and one had a resection and died. There is little wonder that no one was seeing early cancer and could not tell anything about its origin in ulcers or elsewhere. Whatever any one said before 1900 was certainly mere speculation, and still there was a justified clinical and even pathologic suspicion that there might be some relation between ulcer and cancer, because both conditions were the most frequent lesions in the stomach and many cancers were ulcerated.

There was still another fact that had to

be established after the surgeon demonstrated his ability to resect a portion of the stomach without killing his patient. Time was necessary for him to follow his patients after operation to see if he really had prolonged comfortable and useful life. These data were absolutely necessary in order to persuade his medical colleagues to submit their patients to surgical exploration. Krönlein, in 1902, reported that he had four patients alive three years, seven more than two years, and thirteen alive one year after operation. Kocher, in 1904, had six patients alive more than three years, one more than thirteen years, and one alive eight years after operation. The immediate risks were becoming less and less and the post-operative results encouraging, though still few in number. W. J. Mayo, in 1903, reported 277 operations on the stomach with a mortality of 11.2 per cent (benign lesions 6.5 per cent and cancerous lesions 16 per cent). Thus it may be seen that valuable materials were being accumulated for pathologists interested in the subject.

In 1908, Dr. L. B. Wilson and I began our studies of the surgical material of the Mayo Clinic. He began with gastric cancers and I with the ulcers. In 1909 we made the following statement: "Of . . . 153 cases which were undoubted carcinoma, 109 (71 per cent) presented sufficient gross and microscopic evidence of previous ulcer to warrant placing them in a group labeled 'carcinoma developing on preceding ulcer.' " This is the figure which has been so copiously quoted, much to the disgust of those with preconceived ideas and no great material background other than autopsy findings for opinions. Twenty-nine years after that report, and with vastly greater material and experience, I am still of the opinion that in all probability even a higher percentage of gastric cancers have their origin in ulcers. Despite the very probable correctness of this statement *it has nothing to do with what percentage of ulcers become malignant. This is an entirely different question, to a mind properly trained scientifically and linguistically.* In the same year (1909), I reported my studies of gastric ulcer and very emphatically stated: "*The question, 'Do ulcers become malignant as one of their sequelæ?' seems, from my material, at least, to be answered in the affirmative. What percentage heal, perforate, or become malignant is impossible to determine.*" I have, as yet, to see these statements quoted, despite the fact they appeared simultaneously with the statement that 71 per cent of the resected gastric cancers presented evidence of having arisen in ulcer. *Strange as it may seem, a great many distinguished members of our profession are unfortunately and unintentionally dishonest with themselves, and others, when they interpret and quote. Some, apparently, have not appreciated that the word "seems" has nothing positive about it and is a perfectly legitimate word in any scientific working hypothesis.*

Since 1907 I have attempted to study cytologic changes in the borders of ulcers which might be the earliest cancerous changes if cancer really develops in ulcer. In 1914 I published my first detailed report and described definite cytologic changes which I denoted "secondary cytoplasia" (Fig. 1), a condition which differs greatly from ordinary cellular reparative regeneration. Descriptions and illustrations of this condition have appeared many times in my own articles and the characteristic changes have been found in many different tissues of the body. To any one who has studied fresh and unfixed tissues with the oil lens, this picture should be quite well known. It does not appear so beautifully in autopsy material or in tissues long since dead, fixed and embedded in paraffin or celloidin. This being true, general pathologists would not be expected to be familiar with it. I have never been guilty of saying the condition was cancer. Nevertheless, if cancer has a beginning—which it most probably has—secondary cytoplasia is that visible beginning. The cells have all the morphologic characteristics of cancer cells anywhere, despite the fact that they are still in the tubules. That they always become fatal cancer I do not believe, but in which case they will or will not become fatal is at

present not known. I can see no reason for believing that they must always invade the surrounding tissues and the rest of the body. There is plenty of evidence that the body has its own defensive mechanism against such invasion; and it is reasonably possible that this mechanism is successful in the early stages of cancer just as it is in other diseases. There was a time when tuberculosis in the form of "consumption" was recognized only in its fatal stages, just as we, in practice to-day, recognize cancer only in its late stages. Certainly we know now that tuberculosis is recognized and cured long before it has a chance to become "consumption." Some day we shall progress enough to appreciate that cancer, too, has its early stages which can be recognized and cured long before it becomes grossly visible cancer. If we do not do this, we might just as well give up our attempts to solve the problem of cancer. Certainly we have no great right to be exceptionally proud of the way it is handled generally to-day: 75 per cent of gastric cancers (Balfour), 30 to 50 per cent of the mammary cancers (Harrington), and 42 per cent of the large intestinal cancers (Rankin) are inoperable and hopeless when we first see them. Fifty per cent of those operated upon have lymph node involvement, showing they have already extended to other parts of the body, which lessens any possibility of cure in such late stages.

The average size of operable gastric cancers is still 6.1 cm. in diameter which is very large indeed compared to some I have seen as small as 1 cm. in diameter. That we are making progress with gastric cancer is well shown by the fact that I reported recently 121 small gastric cancers the size of, or smaller than, a quarter (2.5 cm. in diameter). The percentage of ulcers which become cancers will very probably never be known; neither will any clinician, radiologist, gastroscopist, or gross pathologist ever be able to tell whether or not small ulcers are malignant. That cannot be done in the early stages of malignancy by any one except a cytologist, and then it can be done only after the ulcer is removed. If secondary cytoplasia is the earliest recognizable stage of cancer, then I know it occurs in from 9 to 15 per cent of all chronic gastric ulcers I have seen. As I have emphasized, this does not mean that 9 or 15 per cent will later be definite cancer, but with no way of telling which will and which will not, I know of no practical way of handling the problem other than by removing all chronic gastric ulcers. The mortality, in the hands of good surgeons with experience, is certainly much less than either 9 or 15 per cent. Quite naturally, I would rather take a chance without operation than be operated upon by a poor surgeon; it might be more useful to live several years with an early and growing cancer than to be dead immediately from a surgical operation. The same conservative idea might be applied to anesthesia, therapeutic radiology, or even chauffering, or cooking. We are interested in expert opinions and practice, not mediocrity.

Now that some of us in the profession know that early, or at least small, cancers do exist, can be found, and removed, it is well to spread the knowledge of how this is done if we are going to continue to propagandize the public with the slogan, "Bring your cancers early." The 121 early or small gastric cancers I have just mentioned would never have been discovered if you radiologists, the operative surgeon, and a fresh tissue cytologist had not existed. You did not exist in 1900: neither did expert gastric surgeons and fresh tissue cytologists. Most textbooks on clinical medicine and medical opinion are just that far behind the times. As an example of this may I quote from one of the most recent editions, written by one of the best medical authorities in this or any other land. He says, in italics, "It is a good rule to suspect cancer in every patient over forty in whom gastric disturbance begins without evident cause." Although this advice is very good it may mislead practitioners of medicine into thinking that a much younger person might not need such thorough attention. I have seen 96 gastric cancers in patients

under thirty years of age, the youngest being eighteen. I had just read the quotation from the medical textbook when I was called to see a patient in the operating room. There I saw a young woman, twenty-five years of age, who was an example of four exceptions to the rule: She was young, a woman, her cancerous ulcer was on the greater curvature rather than the lesser curvature, and she had been x-rayed and correctly diagnosed by a young, small community general practitioner of medicine. Only when general practitioners of his type occupy the offices of our country and medical schools will we begin to solve the cancer problem.

I might, at this point, suggest that all patients with a clinical and hematologic diagnosis of pernicious anemia also have their stomachs and intestines x-rayed. I could hold a dry clinic for two hours any time on the pernicious anemias that have been found to be cancers in the stomach or large intestine. Although they get better after liver, they may, and often do, have a cancer, a bleeding ulcer, or even a bleeding polyp. Even a patient with an inoperable cancer will not infrequently get better and gain weight following a simple exploration.

Before concluding my address may I give you some startling figures which I have compiled recently from a large experience: 14.5 per cent of all gastric ulcers 2.5 cm. in diameter or under, are definitely cancers; only 6.7 per cent of all resected gastric ulcers are larger than 2.5 cm. in diameter; 8.5 per cent of the last 869 gastric ulcers showed secondary cytoplasia and their average diameter was 1.62 cm.; 22 per cent of all gastric carcinomatous ulcers 2.5 cm. or under in diameter have lymph node involvement and their average size is 2.11 cm. in diameter; only 6 per cent of all operable gastric cancers are 2.5 cm. in diameter or under. This last figure does not suggest that the medical profession is doing a very good job in early diagnosis of cancer.

These are the statistical facts derived from that new opportunity which operative gastric surgery, roentgenology, and fresh tissue cytology have given us in the twentieth century. It, therefore, behooves all practitioners of medicine, writers of textbooks, and teachers of medical diagnosis to read them seriously and revamp their ideas of the possible and most probable relation of gastric ulcer to gastric cancer.

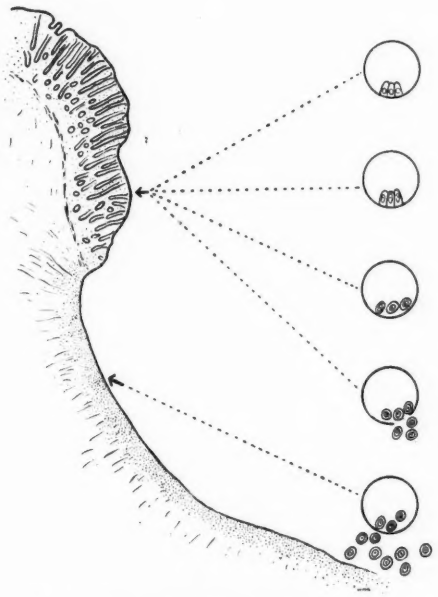

Fig. 1. Diagram showing the cells of gastric tubules as they are seen in the borders of chronic gastric ulcers. From top to bottom one sees: normal cells, reparative regenerative cells, the cells of secondary cytoplasia (cancer?), early migratory cells, and late migratory cells. The last two are definitely carcinoma.

There may be three sources of gastric cancer: chronic gastritis without ulceration, adenomatous polyps, and the mucosal borders of chronic gastric ulcer. The first I have never seen, in an unusually large experience; the second I have seen, but gastric polyps are relatively rare; the third I have seen because chronic gastric ulcer and gastric cancer are relatively very common. In my opinion, most gastric cancers arise in chronic gastric ulcers and the early phases of the cancerous changes are too small to be seen by clinicians, roentgenologists, gastroscopists, operating surgeons,

gross pathologists, or histopathologists. There is excellent evidence for believing that all chronic gastric ulcers must be considered potentially cancerous. I am quite certain that at least 90 per cent of all chronic gastric ulcers larger than a quarter (2.5 cm. in diameter) are definitely cancers.

With these facts in mind a great many chronic gastric ulcers must be removed completely if we expect to prevent the end-results of cancer. Perhaps the best advice I can give to the medical profession is to have all patients with even the slightest upper abdominal distress fluoroscoped by a competent roentgenologist and to keep in close touch with an experienced gastric surgeon.

It is well within reason for us to study roentgenoscopically a small gastric ulcer repeatedly over a few weeks before advising surgery, but certainly it is not wise to delay surgical operation if the ulcer does not disappear completely. Even after its apparent disappearance it also would be wise to make repeated studies—not of the clinical picture but of the fluoroscopic picture. Even in the hands of the best experts I have seen resected gastric cancers which were diagnosed clinically, roentgenoscopically, and gastroscopically as benign ulcers.

In conclusion, may I again express my appreciation of the honor you have given me to pay tribute to our friends, Dr. Carman, his co-worker, Dr. Miller, to Roentgen, and to the magnificent work your Society is doing in developing young radiologists, who will certainly assist greatly in eradicating cancer of the stomach and many other conditions if general practitioners give them a chance.

REFERENCES

1. ABERCROMBIE, J.: Diseases of the Pylorus. Edinburgh Med. and Surg. Jour., **21,** 243–249, 1824.
2. BAILLIE, MATTHEW: The Morbid Anatomy of Some of the Most Important Parts of the Human Body, 314 pages. J. Johnson, London, 1793.
3. BALFOUR, D. C.: Personal communication to the author.
4. BILLROTH, THEODOR: Ueber 124 vom November, 1878, bis June, 1890, in meiner Klinik und Privatpraxis ausgeführte Resectionen am Magen-, Darmcanal, Gastro-enterostomien und Narbenlösungen wegen chronischer Krankheitsprocesse. Wien. klin. Wchnschr., **4,** 625–628, Aug. 20, 1891.
5. CARMAN, R. D.: The Technic of Roentgen-ray Examination of the Gastro-intestinal Tract, and the Interpretation of Screen and Plate Findings. Jour. Am. Med. Assn., **61,** 321–327, Aug. 2, 1913.
6. FORSSELL, GÖSTA: Über die Beziehung der Röntgenbilder des menschlichen Magens zu seinem anatomischen Bau. Fortschr. a. d. Geb. d. Röntgenstrahlen, Ergänzungsband, **30,** 265 pages, 1913.
7. GROEDEL, F. M.: Die Magenbewegungen. Fortschr. a. d. Geb. d. Röntgenstrahlen, Ergänzungsband, **27,** 40 pages, 1912.
8. HALSTED, W. S. (Quoted by Garrison, F. H.): An Introduction to the History of Medicine, with Medical Chronology, Suggestions for Study, and Bibliographic Data. Second edition, p. 741. W. B. Saunders Co., Philadelphia, 1917.
9. HARRINGTON, S. W.: Personal communication to the author.
10. HAUSER, G.: Das chronische Magengeschwur; sein Vernarbungsprocess und dessen Beziehungen zur Entwicklung des magen Carcinoms. P. C. W. Vogel, Leipzig, 1883.
11. HOLZKNECHT, GUIDO: The Roentgen Diagnosis of the Stomach. Arch. Roentgen Ray, **16,** 206–217, November, 1911.
12. HAUDEK, M.: Die Technik und Bedeutung der radiologischen Motilitätsprüfung. Verhandl. d. deutsch. Kong. f. inn. Med., **29,** 143–148, 1912.
13. KOCHER: Résultats définitifs de l'excision de l'estomac. Presse méd., **1,** 667, Oct. 19, 1904.
14. KRÖNLEIN: Ueber den Verlauf des Magencarcinoms bei operativer und bei nicht operativer Behandlung. Eine Bilanzrechnung. Verhandl. d. deutsch. Gesellsch. f. Chir., pp. 88–104, April, 1902.
15. MACCARTY, W. C., and BRODERS, A. C.: Chronic Gastric Ulcer and its Relation to Gastric Carcinoma: Review of 684 Specimens. Arch. Int. Med., **13,** 208–223, February, 1914.
16. MAYDL, KARL (Quoted by Garrison, F. H.): An Introduction to the History of Medicine, with Medical Chronology, Suggestions for Study, and Bibliographic Data. Second edition, p. 629. W. B. Saunders Co., Philadelphia, 1917.
17. MAYO, W. J.: Cicatricial Stenosis and Valve Formation as a Cause of Pyloric Obstruction, with a Report of Five Cases Relieved by Operation. Jour. Am. Med. Assn., **29,** 778–781, Oct. 16, 1897.
18. Idem: The Surgical Treatment of Diseases of the Stomach. Philadelphia Med. Jour., **5,** 299–303, Feb. 3, 1900.
19. Idem: A Review of 303 Operations upon the Stomach and First Portion of the Duodenum, with Tabulated Report of 313 Operated Cases. Ann. Surg., **38,** 30–46, July, 1903.
20. MORGAGNI, J. B.: The Seats and Causes of Diseases Investigated by Anatomy, vol. 2, book 3, 770 pages. Johnson and Payne, London, 1769. (Translated by Benjamin Alexander from: De sedibus et causis morborum per anatomen indagatis libri quinque. Dissectiones, et animadversiones, nunc primum editas complectuntur propemodum innumeras, medicis, chirurgis, anatomicis profuturas, 2 vols., 298 pages; 450 pages. Venetiis, Remondiniana, 1761.)
21. MURPHY, J. B. (Quoted by Garrison, F. H.): An Introduction to the History of Medicine, with Medical Chronology, Suggestions for Study, and Bibliographic Data. Second edition, p. 742. W. B. Saunders Co., Philadelphia, 1917.
22. OSLER, WILLIAM: Lectures on the Diagnosis of Abdominal Tumors. New York Med. Jour., **59,** 129–134, Feb. 3; 161–165, Feb. 10; 193–198, Feb. 17; 260–265, March 3; 385–389, March 31; 417–422, April 7; 481–488, April 21; 545–550, May 5; 577–582, May 12, 1894.

   Lectures on the Diagnosis of Abdominal Tumors, Delivered to the Post-graduate Class, Johns Hopkins

University, 1893. D. Appleton & Co., New York, 1894. (Reprinted, D. Appleton & Co., New York, 1901.)

23. OSLER, WILLIAM, and MCCRAE, THOMAS: Cancer of the Stomach: A Clinical Study, 157 pages, P. Blakiston's Son & Co., Philadelphia, 1900.

24. RANKIN, F. W.: Personal communication to the author.

25. VON ROKITANSKY, CARL: Handbuch der allgemeinen pathologischen Anatomie. Wien. Braumüller u. Seidel, 1842.

26. ROENTGEN, W. C.: Ueber ein neue Art von Strahlen. Sitzungsb. d. phys.-med. Gesellsch. zu Würzb., pp. 132–141, 1895.

27. Idem: Ueber ein neue Art von Strahlen. Sitzungsb. d. phys.-med. Gesellsch. zu Würzb., pp. 11–19, 1896.

28. Idem: On a New Kind of Rays. Science, **3,** 227–231, Feb. 14, 1896.

29. WELCH, W. H.: Cancer of the Stomach. In Pepper, William: A System of Practical Medicine by American Authors. **2,** 530–579. Lea Brothers & Co., Philadelphia, 1885.

30. WÖLFLER, ANTON: Gastro-enterostomie. Zentralbl. f. Chir., **8,** 705–708, Nov. 12, 1881.

31. WILSON, L. B., and MACCARTY, W. C.: The Pathological Relationships of Gastric Ulcer and Gastric Carcinoma. Am. Jour. Med. Sci., **138,** 846–852, December, 1909.

The Pathological Relationships of Gastric Ulcer and Gastric Carcinoma. Trans. Assn. American Physicians, **24,** 593–602, 1909.

ADDITIONAL BIBLIOGRAPHY[2]

1. ABERCROMBIE, JOHN: Pathologic and Practical Researches on Diseases of the Stomach, the Intestinal Canal, the Liver, and Other Viscera of the Abdomen. Third American edition from second London edition, 320 pages. Carey, Lea and Blanchard, Philadelphia, 1838.

2. BILLROTH, THEODOR (Quoted by Garrison, F. H.): An Introduction to the History of Medicine, with Medical Chronology, Suggestions for Study, and Bibliographic Data. Second edition, p. 626. W. B. Saunders Co., Philadelphia, 1917.

3. CARMAN, R. D.: The Roentgen Ray as an Aid in the Diagnosis of Gastric Cancer and Ulcer. Jour. Indiana Med. Assn., **6,** 485–505, Nov. 15, 1913.

4. Idem: The Roentgen Diagnosis of Gastric Ulcer. Am. Jour Roentgenol., **1,** 233–251, 1913–1914.

5. GROEDEL, FRANZ: The Influence of Various Contrast Substances on the Motility of the Intestinal Canal. Arch. Roentgen Ray, **17,** 420–422, April, 1913.

6. HAUDEK, MARTIN: Über die radiologische Prüfung der Magenmotilität und ihre Resultate. Fortschr. a. d. Geb. d. Röntgenstrahlen, **21,** 472–479, 1914.

7. MACCARTY, W. C.: Pathology and Clinical Significance of Stomach Ulcer, from a Study of the Material from 216 Partial Gastrectomies for Ulcer, Ulcer and Carcinoma, and Carcinoma. Surg., Gynec. and Obst., **10,** 449–462, May, 1910.

8. Idem: The Histogenesis of Cancer of the Stomach. Am. Jour. Med. Sci., **149,** 469–476, 1915.

9. Idem: The Pathologic Reasons for the Legitimate Error in X-ray Diagnosis of Gastric Carcinoma and Ulcer. Am. Jour. Roentgenol., **4,** 67–75, February, 1917.

10. Idem: Chronic Gastric Ulcer and Gastric Carcinoma: A Study of 507 Simple Chronic Ulcers and 895 Carcinomatous Ulcers. Am. Jour. Roentgenol., **7,** 591–596, December, 1920.

11. Idem: Pathology of the Peptic Ulcer. Jour. Michigan Med. Soc., **20,** 5–8, January, 1921.

12. Idem: Does Cancer Arise in Chronic Gastric Ulcer? Jour. Am. Med. Assn., **79,** 1928, 1929, Dec. 2, 1922.

13. Idem: Chronic Ulcer and Carcinoma of the Stomach. Am. Jour. Med. Sci., **173,** 466–472, April, 1927.

14. Idem: Early Cancer of the Stomach. Jour. Cancer Research, **12,** 1–8, March, 1928.

15. Idem: A Review of the Gastric Carcinoma-ulcer Problem. Col. Papers, Mayo Clin. and Mayo Foundation, **22,** 41–50, 1930.

16. Idem: Practical Lessons from the Study of Size of Cancers. Proc. Staff Meet., Mayo Clin., **7,** 305–308, May 25, 1932.

17. Idem: The Size of Operable Cancers: A Study of 7,179 Specimens. Am. Jour. Cancer, **17,** 25–33, January, 1933.

18. Idem: Why Cancer is not Recognized Early. Am. Jour. Cancer, **22,** 831–837, December, 1934.

19. Idem: Surgical Pathology of Stomach and Duodenum. In Eusterman, G. B., and Balfour, D. C.: The Stomach and Duodenum, pp. 73–87. W. B. Saunders Co., Philadelphia, 1936.

20. Idem: Early Cancer of the Stomach and its Clinical Significance. Am. Jour. Digest. Dis., **5,** 549–554, November, 1938.

21. Idem: A Hopeful Factor in the Cancer Problem. Am. Jour. Cancer, **35,** 275, 276, February, 1939.

22. MACCARTY, W. C., and BLACKFORD, J. M.: Involvement of Regional Lymphatic Glands in Carcinoma of the Stomach from a Study of 200 Resected Specimens. Ann. Surg., **55,** 811–843, June, 1912.

23. MACCARTY, W. C., and MAHLE, A. E.: Relation of Differentiation and Lymphocytic Infiltration to Post-operative Longevity in Gastric Carcinoma. Jour. Lab. and Clin. Med., **6,** 473–480, June, 1921.

24. MACCARTY, W. C., and NADEAU, OSCAR: Benign Neoplasms of the Stomach. Trans. Chicago Path. Soc., **10,** 51, 52, April 1, 1916.

25. MILLS, R. W., and CARMAN, R. D.: The X-ray in the Diagnosis of Gastric Ulcer and its Sequelæ. Surg., Gynec. and Obst., **17,** 1–25, July, 1913.

26. MORGAGNI, J. B. (Quoted by Garrison, F. H.): An Introduction to the History of Medicine, with Medical Chronology, Suggestions for Study, and Bibliographic Data. Second edition, p. 352. W. B. Saunders Co., Philadelphia, 1917.

[2] Relevant articles not referred to in the text.

PHYSICAL FACTORS INFLUENCING THE DIFFERENCE BETWEEN 200 AND 500 KILOVOLT RADIATION[1]

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THE subject of this paper is an analysis of the depth dose produced by two qualities of radiation when all of the other factors were held constant. No detailed historical introduction is given, for the subject is well known, and the number of people who have contributed are numerous. An excellent analysis of the problem at another voltage has been given by Parker (1), although we have not used his method of attack.

It is generally accepted that the depth dose found for any quality of radiation at any given target–skin distance can be increased by increasing this distance. Also that the numerical value of the depth dose can be increased by increasing the size of the treatment portal. Both of these factors, however, prove to be self-limiting. The rate at which the surface intensity decreases with distance puts a sharp economic limit on this method, and it has been shown by Mrs. Quimby (2) that increases in target–skin distance of more than about ten times the tumor depth are physically unprofitable also. Simple considerations of absorption and scattering show that much beyond 100 cm. the inverse square law is no longer the dominant factor in determining the depth dose, and no further real gain is to be made unless we go to very extreme distances as in the Heublein technic. Even then, at what can be called an infinite distance, we cannot get a 100 per cent depth dose.

Dr. Randall (3) has recently published a complete set of depth dose data taken at voltages from 150 to 300 kv., with varying filter thicknesses and a field size of 25 × 25 cm. On the highest quality radiation he was able to get a depth dose of about 54 per cent. This method is also limited, however, by the fact that a large field supplies a very poor quality of radiation in the depth, even though it offers a very good numerical quantity. Physically, the only way that the quality of the radiation can be kept up is by keeping the field size small and the target–skin distance long, and then making up the quantity of the depth dose by the use of a number of small ports. Again, we must admit two sharp limitations on this proposal. In the first place, the physician rightly insists upon a size of portal adequate to cover the lesion and a reasonable margin around it. Secondly, it is technically difficult to make safe and practical use of numerous small portals on the human body wherein the motility and variability of size of the normal underlying structures with respect to the skin make a constant threat of inadequate or disastrous treatment when a large number of small fields are used.

These considerations were a factor in the adoption of higher voltages, but here again we find ourselves limited. It was predicted, and has been adequately borne out, that with reasonable portal sizes and target–skin distances the numerical value of the depth dose would not be vastly changed over that at 200 kv. Further, it can easily be shown that great increases in voltages do not result in very great increases in the numerical depth dose. It follows then that if the higher voltages have any real advantage over 200 kv., we must look elsewhere for the reason.

There are two logical places to begin such a search. It has long been believed that the high speed electron was a major factor in the biological effect of radiation, and this concept, while not yet adequately proven, is gathering more weight all the time. It has been shown that the production of

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

high energy Compton electrons is in accord with the theory, and a more recent research by Trueblood and Loughridge (4) has not only demonstrated this again, but has brought to light a fact which promises to be of vast importance in this work, namely, that the production of high energy photo-electrons at 800 kv. is many times greater than the prediction.

It is probable then that although there is no biologic dependence on wave length, the superiority of the higher voltages depends primarily upon the ability of the higher voltage radiation to reach the depth unchanged in wave length in sufficient quantity to be effective. That this effectiveness probably depends upon the radiation having sufficient energy to set free high speed electrons in the depth is still subject to discussion, and need not concern us further here.

We have limited this analysis to a portal of just one size and one target–skin distance. These values are chosen simply because they are probably the most widely used of these factors. In all measurements shown, the field size is 20 × 20 cm., and the distance 60 cm.

The first distinguishing factor between 200 kv. and the higher voltages is the back-scatter. It is this factor primarily which makes it possible to apply more primary radiation to the skin, and hence to the underlying tumor.

The back-scatter is measured by placing the measuring instrument with its chamber one-half immersed in the material of the phantom on the side of the phantom facing the target. Throughout the series of measurements the chamber is held at the predetermined distance, while the material of the phantom is built up behind it. The percentage increase in intensity over the measurement in free air is then plotted (5). This value increases with increasing thickness of the backing material until an equilibrium value is reached, beyond which no further increase in the backing material will give an increase in the reading. This equilibrium value is the percentage back-scatter, and its numerical value as well as the thickness of backing material necessary to attain it are constants, and are characteristic of the quality of the primary radiation. This is the only series of measurements in this analysis in which the chamber retains a fixed position.

If now the phantom is divided in a different manner, the forward scatter radiation can be measured. This is done by setting the phantom up with one surface at the treatment distance, and the chamber half immersed in the surface, distant from the target. We then have no material beyond the chamber to contribute "back-scatter." The slabs of presdwood of which the phantom consists are now slipped into the frame between the target and the chamber, keeping the surface always at the treatment distance and moving the chamber back as the thickness of the material increases. It must be pointed out that certain precautions in terminology are necessary here. The description given for the term "back-scatter" is adequate. However, the radiation which passes through the forward part of the phantom before reaching the chamber undergoes various kinds of scattering, and may pass through several scattering angles before reaching the chamber. Therefore, for this purpose only, we offer the limited definition "forward scatter"; that it is all of the scattered radiation which comes from the fore part of the phantom and passes through the chamber at an angle less than ninety degrees from the direction of the primary beam. The back-scatter by contrast would be all of the scattered radiation which passes through the chamber at an angle greater than ninety degrees from the direction of the primary beam.

Figure 1 shows the curves obtained by measuring in this manner. As the thickness of material is increased the beam is attenuated by the absorption and the inverse square law, and is amplified by the forward scattered radiation. The curve then represents the residue of the primary beam at any depth, with the intensity of forward scattered radiation added. The point taken as 100 per cent is the surface

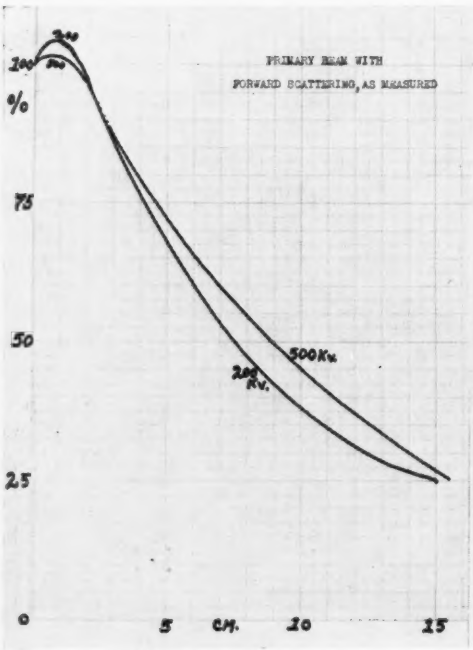

Fig. 1.

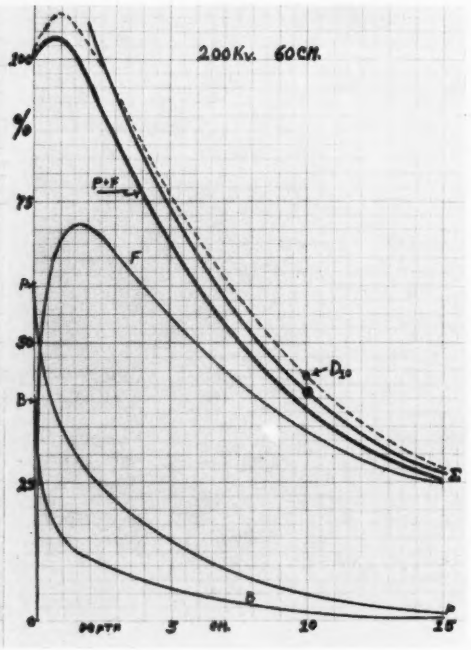

Fig. 2.

intensity rather than the free air intensity since we are analyzing the relationship between the surface and the depth dosages. The first part of the curve is of considerable interest although the numerical values are not to be considered accurate. The chamber itself has a thickness (or rather a diameter) of one centimeter, and this much foreign material in a total thickness of phantom material less than two cm. is too much of a disturbance to be ignored. This will be referred to again in connection with the measurement of total depth dose. Beyond the point where the chamber has a full centimeter of material in front of it, that is beyond the depth of fifteen millimeters, the numerical values can be considered accurate.

The actual absorption of the primary can now be measured by taking a collimated beam of small diameter. The absorption curve was corrected for the inverse square law decrease by moving the chamber, so that the net result is a true picture of the attenuation of the actual primary beam in the depth of the phantom. Figure 2 shows this whole group of measurements taken at 200 kv. The curve marked "P + F" is the combination of primary and forward scattered radiation measured through the fore part of the phantom without backing. The curve "P" is the attenuation curve for the primary. We then derive the curve "F" by subtracting these two, "F" being as true a picture as we can get of the total scattered radiation contributed by the fore part of the phantom. Then there is to be added "B," the constant percentage of the primary contributed by the back-scatter, and we have all of the elementary contributions to the depth dose curve.

This curve shows that of every hundred units of radiation applied to the surface of the phantom, about thirty-eight units exclusive of the back-scatter will reach a depth of 10 cm. Of this thirty-eight units, only nine will be primary radiation, and twenty-nine will be scattered radiation supplied by the bulk of material lying be-

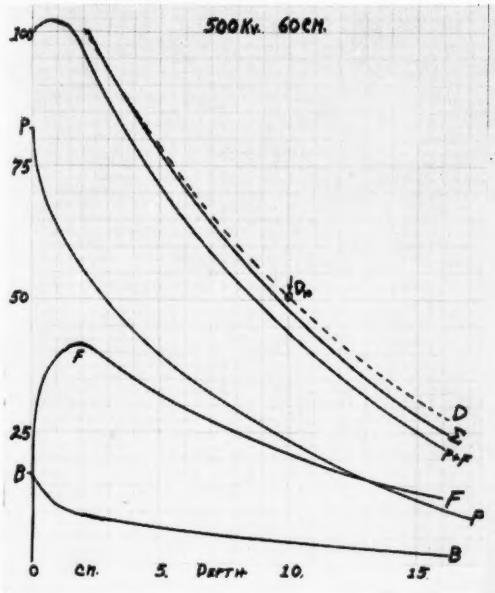

Fig. 3.

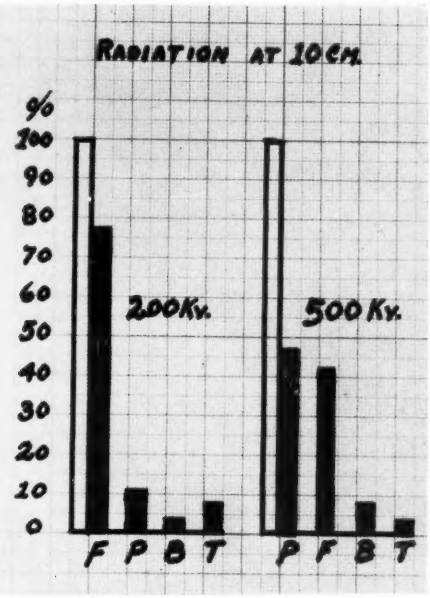

Fig. 4.

tween the chamber and the surface. A considerable amount of work on the qualitative analysis of this scattered radiation has already been done, and it is known that the quality distribution of this forward scatter varies all the way from the hardness of the primary beam down to the extremely low voltage radiation. In general, it can be considered soft radiation.

The values shown on the curves F, P, and B, if simply added, should give us a curve which closely approaches the depth dose curve. We have designated this summarized depth dose curve "Sigma," and it is shown with a measured depth dose curve in Figure 2. So far the fact has not been mentioned, but it is obvious that when the whole phantom is put together the forward scattered radiation crossing the plane which contains the chamber will strike the distant portion and add another component of back-scatter, and other minor scattering effects will take place. The difference between the actual depth dose curve and the curve for Sigma gives us a measure of the value of these further scattering effects, which, for the purpose of this analysis, is arbitrarily designated as "Tertiary." This group of curves shows that at 200 kv., under the conditions stated, all of these Tertiary effects lumped together contribute a component at 10 cm. equal to about twice the back-scatter of the primary beam.

The point to be particularly noted about this 200 kv. analysis is the wide spread between the primary and forward scatter curves, which have the ratio of five units to thirty-four. Contrast this with Figure 3, which shows the same analysis at 500 kv.

In this case the primary and forward curves are practically together, having a ratio of twenty-one to twenty-four. This figure shows the complete analysis at this voltage, and it is shown that of the forty-nine units of radiation accounted for on the summation curve out of the original hundred, twenty-four are accounted for by the primary, twenty-one by the forward scatter, and four by the back-scatter. The depth dose curve superimposed gives

two units as the contribution of the Tertiary effects.

Note again the shape of the depth dose curve at depths less than two cm. The difference in percentage back-scatter is, of course, one of the most important factors in the difference in threshold erythema dose between various qualities of radiation, but it is obvious that this factor alone does not account for the whole difference. It seems certain from these measurements—and further borne out by theoretical considerations—that in the very superficial layers where the primary is at practically full intensity, the back-scatter is at full intensity, and the forward scatter is building up rapidly, dosages are encountered which are appreciably greater than the surface dose. This is an important problem which can be solved only by measurement with a very small or a very thin chamber such as the extrapolation chamber, or by biologic means.

Figure 4 shows the constituents of the radiation at 10 cm. depth as percentages of the total radiation present at that depth. It is shown that the composition of the radiation at this depth is quite different with the two qualities used. We feel safe in believing that this difference, rather than the numerical value of the depth dose, is the real difference between the various qualities of radiation.

REFERENCES

(1) PARKER, H. M.: Dependence of Back-scattering of Roentgen Rays in Phantom on Focal Distance, Quality of Radiation and Field Size. Acta Radiol., **16,** 705–715, 1935.

(2) QUIMBY, E. H., and ARNESON, A. M.: A Comparison of Paraffin and Water Phantoms for Roentgen-ray Depth Dose Measurements. Am. Jour. Roentgenol. and Rad. Ther., **37,** 93–97, January, 1937.

(3) RANDALL, CLYDE L.: The Effect upon the Percentage Depth Intensity of Increase in Voltage, Filtration, and Skin-target Distance (150–300 kv., peak). Am. Jour. Roentgenol. and Rad. Ther., **38,** 903–914, December, 1937.

(4) TRUEBLOOD, HAROLD C., and LOUGHRIDGE, DONALD H.: The Scattering and Photo-electric Absorption of High Voltage X-rays in Nitrogen. Phys. Rev., **54,** 545–554, 1938.

(5) CORRIGAN, K. E., CASSEN, B., and HAYDEN, H. S.: Spatial Distribution of Radiation from a Supervoltage Roentgen Tube—II. Am. Jour. Roentgenol. and Rad. Ther., **39,** 634–640, April, 1938.

We would like to call attention to an excellent study of this subject which has appeared since this paper was prepared: J. R. Clarkson and W. V. Mayneord: "Quality" of High Voltage Radiations, Part II. British Jour. Radiol., **12,** 168–180, March, 1939.

THE DIFFERENCES BETWEEN 200 KILOVOLT AND SUPERVOLTAGE ROENTGEN THERAPY[1]

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From the Department of Radiology, Collis P. Huntington Memorial Hospital, Harvard University

IN spite of the differences of opinion regarding the relative value of high voltage and supervoltage roentgen rays, the trend in the radiation of malignant disease is toward the use of the shorter wave lengths. In most clinics where large amounts of radium are available, it has been the impression that telecurie therapy possesses advantages over the use of 200 kilovolt roentgen rays. Unfortunately, the supply of radium is small, and its use for external radiation at a distance is not economically feasible. The production of roentgen rays of wave lengths approaching the gamma rays of radium has been the endeavor of physicists and manufacturers of roentgen apparatus for a number of years.

The use of electrostatic machines for the generation of roentgen rays is not new. Most of the early apparatus was built on this principle. However, the more or less unreliable "static machines" gave way to transformer units both for diagnostic and therapeutic work.

Recently, a modification of the electrostatic principle of high voltage generation for research in nuclear disintegration was developed by Van de Graaff and his associates. It occurred to these workers that this new electrostatic generator afforded an ideal source of high potential for the production of supervoltage roentgen rays. The high voltage research group at the Massachusetts Institute of Technology designed and built a supervoltage roentgen therapy unit which was put into operation for the treatment of malignant disease at the Collis P. Huntington Memorial Hospital, Harvard University. This machine has been in use for two years and although a number of minor defects have had to be corrected, the unit has proved sound in principle and reliable in operation (1, 2).

The routine operating factors are: 1,000,000 volts constant potential; 70 cm. distance; 3 mm. of lead plus 7.75 mm. of copper filter; 1 to 1.5 ma. An output of from 60 to 70 roentgens per minute (air measurement with a thimble chamber of standard design) is obtained with this setting. Although the unit is capable of developing higher amperage, the roentgen output is so high that we have not found it necessary to use the apparatus at full capacity.

Absorption measurements in copper are shown in Figure 1. It will be noted that the half value layer is 10.5 mm. as compared with from 1 to 2 mm. of copper for 200 kv. rays. The 10 cm. depth dose using a 100 sq. cm. portal of entry is 50 per cent. This is some 15 to 20 per cent higher than the depth dose measured under similar conditions on a 200 kv. unit.

Surface back-scattering is greatly decreased at the higher voltage. On our unit there is only 8 per cent back-scatter with a 100 sq. cm. field as compared with approximately three times this amount for 200 kilovolts. The lateral scattering within the depths is far less than at lower voltage, so that the volume of tissue irradiated is closely defined by the portal of entry. The exit dose at 1,000,000 volts is high, averaging about 20 per cent in the pelvis of normal size.

One-fourth inch of lead is considered sufficient protection from the direct beam of 200 kv. rays. Six inches of lead have been found necessary to absorb 1,000,000

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

volt rays. The scattered radiation of supervoltage rays is much longer in wave length than the primary beam, and our measurements have shown that one foot of cement affords good protection (3).

developed stiff erythemas, the reaction can be attributed largely to the exit dose.

The reaction of the mucous membranes appears in a shorter time following supervoltage therapy. For a given skin re-

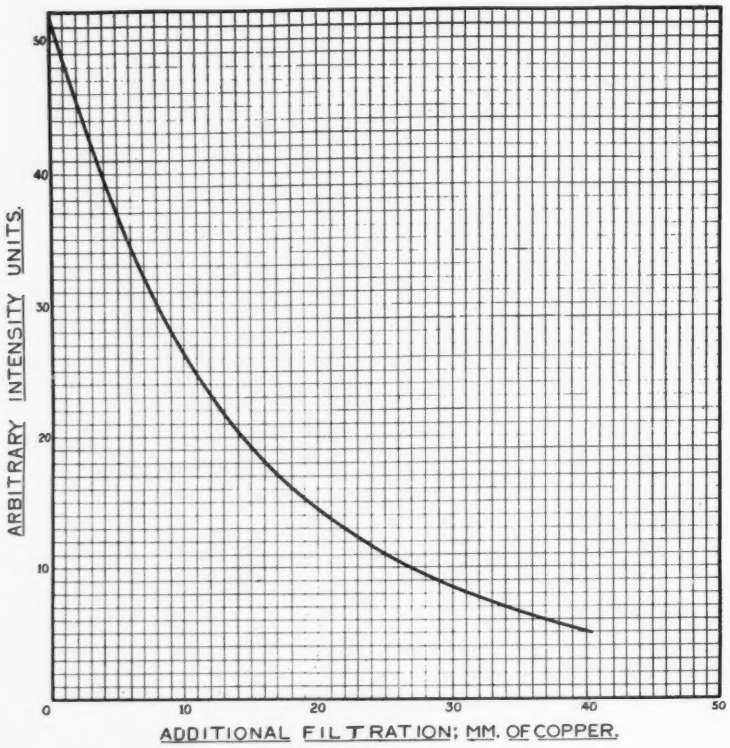

Fig. 1.

It has been observed that there is a difference in skin tolerance for supervoltage roentgen rays as compared with those generated at the usual 200 kilovolt potential. If one measures intensities in air, the tolerance for 1,000,000 volt rays is approximately double. If measurements are made with back-scattering, the discrepancy is less, but there is still a pronounced difference in favor of the shorter wave lengths. Not only have the immediate superficial reactions been less intense, but late skin damage in our two years' experience has been essentially absent. In those few cases which have

action it is much more intense, and its distribution is more even. It is our impression that the mucositis is of shorter duration than when produced at lower voltage, and, therefore, the period of discomfort is more brief.

The problem of roentgen sickness has always been an important one. We have repeatedly observed that for portals of entry of corresponding size the symptoms of roentgen sickness have been less pronounced at the higher voltage. In numerous instances we have transferred patients from the 200 kilovolt unit to the 1,000,000 volt unit because of the lessened

general reaction with the latter type of therapy. A reasonable explanation for this seems to lie in the fact that the lateral scattering from the higher voltage is less, and the volume of tissue irradiated is correspondingly decreased.

The effect on the hemopoietic system is more profound with the shorter wave lengths. Although we have observed no marked changes in the erythrocyte count, a rapid diminution in the leukocytes occurs at the end of the series, with a disturbance of the lymphocyte ratio. This becomes most apparent when large fields are employed. The return of the white count to normal following the completion of the treatment is more delayed than at 200 kilovolts. We have observed only a slight decrease in the platelet count.

Whether or not there is a difference in the biologic effect of different roentgen wave lengths is a subject which is still under discussion. Irradiation of testicular tumors in rabbits with rays produced at from 50 to 1,000 kv. has shown no difference in the number of roentgen units necessary to produce a lethal effect on the neoplasm. The irradiation of *Drosophila* eggs, both on the surface and in the depths of a phantom, has yielded interesting results. Whereas the 200 kv. rays are slightly more effective in killing the eggs on the surface, the supervoltage rays become much more efficacious in the depths.

This coincides with our clinical experience in treating deep-seated neoplasms. The reaction in the deeper tissues is more pronounced than our ionization measurements would lead us to expect. Whether this is due to a difference in biologic effect or is the result of the failure of our thimble ionization chamber to measure the full intensity of radiation, we cannot say.

Much has been written regarding the amount of radiation necessary to control various types of malignant disease. Not only is the total dosage important, but the time element is of equal significance. In the treatment of superficial malignancies the progress of which under radiation may be carefully followed, we have learned that too small a fractionation of dosage is undesirable. In the treatment of deep-seated neoplasms, the tendency is to devote our attention to the surface dose rather than to that delivered to the tumor. This is natural, since with 200 kv. therapy the depth dose has been limited, especially when small portals are used, not by the reaction of the deeper tissues, but by the reaction of the skin. In employing supervoltage rays, the conditions are reversed. With small fields on the supervoltage unit, the 10 cm. depth dose remains close to 50 per cent even though portals of less than 100 sq. cm. are employed. At 200 kv., there is a rapid falling off in depth dose with decrease in portal size. The superficial reaction is of such small significance that we can now devote our attention to what goes on below the surface. Although we have seen complete clinical regression of epidermoid carcinoma of the cervix and bladder (4, 5) following a dose to the tumor itself of from 3,000 to 3,500 roentgens, delivered within a period of three weeks, it is our belief that this amount of radiation will not permanently control these lesions any more than it will a similar type of neoplasm on the skin. It will be necessary either to give a larger tumor dose with the same fractionation, or to apply the same dose in a much shorter period of time. Although we have thus far encountered no serious immediate difficulties, we are aware that overdosage of normal structures may lead to highly undesirable late reactions. It is our feeling, therefore, that it is necessary to proceed with caution and that the safe therapeutic dose of supervoltage roentgen rays can be reached only after a period of several years of careful observation.

In summary, the advantages of supervoltage radiation are as follows: less skin damage; a larger depth dose, which is biologically greater in effect than our ionization measurements indicate; a depth dose largely independent of the size of the portal of entry; less general reaction on the part of the patient, and more satis-

factory immediate regression of deep-seated neoplasms.

REFERENCES

(1) TRUMP, J. G., and VAN DE GRAAFF, R. J.: Design of a Million-volt X-ray Generator for Cancer Treatment and Research. Jour. App. Phys., **8,** 602–606, 1937.

(2) DRESSER, R., TRUMP, J. G., and VAN DE GRAAFF, R. J.: The Production of Supervoltage Roentgen Rays by Means of an Electrostatic Generator. Am. Jour. Roentgenol. and Rad. Ther., **38,** 758–761, November, 1937.

(3) DRESSER, R., and COSMAN, B. J.: Million-volt Roentgen-ray Protection. Am. Jour. Roentgenol. and Rad. Ther., **39,** 972, 973, June, 1938.

(4) DRESSER, R., and RUDE, J. C.: Supervoltage Roentgen Treatment of Carcinoma of the Bladder. Jour. Am. Med. Assn., **111,** 1834–1837, Nov. 12, 1938.

(5) DRESSER, R., MEIGS, J. V., and RUDE, J. C.: The Combined Roentgen-ray and Radium Treatment of Carcinoma of the Cervix. Am. Jour. Roentgenol. and Rad. Ther., in press.

THE BIOLOGICAL MEASUREMENT OF HIGH VOLTAGE RADIATIONS[1]

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THE need for making biologic measurements of the effectiveness of x-radiations and of gamma rays has long been realized. With the recent development of high voltage therapy, it is increasingly felt because both clinical and experimental evidence indicate that the quantitative effects of very short radiations, the doses of which are measured by the dosimeters now available, do not conform with the expectation. Past experience with lower voltage beams has led us to expect that certain magnitudes of reactions will follow definite doses. But it is now observed that when supposedly the same doses of short wave radiation are given, the amount of effect is less than anticipated. This fact is illustrated by recent observations of Sievert (6) who finds that, when gamma rays are applied to the skin under standard conditions of filtration and distance, the reaction is what would be expected if the intensity of the radiations were about 5 r/mg.-hr. But his own most careful physical measurements, and those of many other investigators, indicate that the intensity, under the same conditions, is about 8 r/mg.-hr. Thus the biological dose is about 60 per cent of the physical dose. These observations agree with the results of earlier experiments with *Drosophila* eggs (1, 2). The data presented in this paper also point to the conclusion that the same difference, in a smaller degree, is found in experiments with high voltage radiations.

To explain the marked differences between doses measured biologically and physically, it might be assumed either that the physical measurements are incorrect, or that the very short radiations are biologically less effective than softer rays. That doses of supervoltage x-rays have not been satisfactorily measured in terms of standard roentgens is generally admitted. According to Taylor and Singer (8), who have made an elaborate study of the subject, it should be possible to measure them, but these writers do not claim that they have yet completely succeeded. In their experiments they used apparatus far more complicated than any that could be employed in ordinary laboratories. Until measurements of supervoltage radiations are satisfactorily made, and until our commercial dosimeters are calibrated against such a standard ionization chamber, we cannot be sure of the magnitude of the doses actually delivered. Without this assurance, we cannot test the validity of the second assumption regarding the relative effectiveness of different x-ray wave lengths. We do not know whether 500 r of 200 kv. x-rays are as effective on small biologic objects as 500 r of 1,000 kv. x-rays, because we cannot now deliver exactly this dose of the latter radiation. In view of these difficulties in physical measurement it is obvious that biologic measurements must be made, since it is the biologic effectiveness of the radiations, regardless of the exact physical dosage, which is of immediate importance.

The use of the eggs of the fruit fly, *Drosophila*, for this purpose is now well established. The experience of many years strengthens the belief that this material is admirably adapted for quantitative work. Whenever a test is made, approximately the same proportion of eggs in a sample survives after receiving a definite dose. This is true whether the radiation is very soft, produced at 12 kv., or moderately hard, produced at 220 kv. Some hundreds of tests made during the past

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

ten years allow us to predict with great precision what will be the effect which follows any measured dose between 100 and 350 roentgens, these doses resulting in survival rates of 86 and 15 per cent, respectively. Similarly, from the proportion that survives after exposure, it is possible to determine with no less precision what doses the eggs actually received. Thus, experience shows that 190 r, measured in air without scatter, kills half of the eggs in a sample. If, then, the test objects are exposed to a beam of unmeasured intensity, and the death rate is found to be 50 per cent, we are justified in assuming that they have received the equivalent of 190 r. It should be emphasized that the technic of the method is by no means simple, and that consistent results can be obtained only when very careful attention is paid to the various experimental procedures.

In arriving at the above assumption it should be made clear that it is not claimed that the dose, measured biologically in this way, necessarily amounts to 190 standard roentgens. For this reason it should be expressed in terms such as "equivalent" or "biologic" roentgens. The use of these terms should not lead to any confusion. They imply that the biologic effectiveness of the dose in question is equivalent to that of a dose accurately measured in standard roentgens.

Using this biologic method, my colleague, F. M. Exner, and I have made three series of experiments, using voltage from 220 to 900 kv. The first series consists in tests for the purpose of calibrating the Victoreen dosimeter against the biologic standard; the second, a measurement of surface doses, and the third, of depth doses in a water phantom. This work is still in progress, but sufficient has already been done to warrant a presentation of the results. Further experimentation may make necessary some revision of the figures given here, but no important changes are anticipated.

All of the tests have been made on the same x-ray machine which is of the radio-frequency type developed by Sloan at the University of California. The x-rays are obtained from a tungsten target at an angle of 90° from the electron beam. The distance between the target and the eggs exposed in air or at the surface of the phantom is 70 cm.; the portal area in every case is 100 sq. cm., and the intensity, as measured by the Victoreen dosimeter, about 30 r/min. The dosimeter was recently calibrated by the makers. Repeated readings made before and after ex-

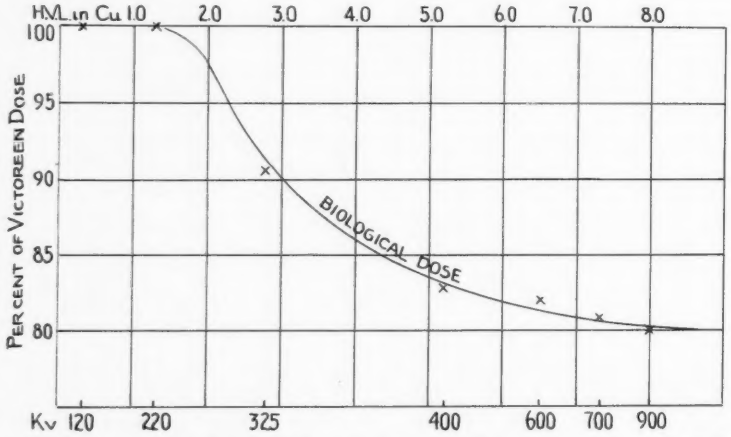

Fig. 1. At voltage above 400 kv. the x-ray intensity, measured by biological means, is about 80 per cent of the intensity measured by the Victoreen dosimeter.

posure showed that the intensity did not vary significantly during the experiments. In the tests to measure the biologic intensity of the beams in air, without scatter, the eggs were placed on a sheet of celluloid 0.4 mm. in thickness and covered with another sheet 0.8 mm. thick. These were supported on a gauze strip. The addition of the celluloid sheets is for the purpose of assuring that the intensity of secondary beta radiation everywhere within the test material will be in equilibrium with the incident primary radiation. The condition of irradiation of the eggs will then be analogous to that of the air inside a thick-walled thimble chamber. At the lower voltages the presence or absence of the celluloid makes no difference in the biologic result, but at voltages of 600 kv. and higher the effect of its presence is noticeable, the biologic intensity of the beams being increased by about 15 per cent. The thickness of celluloid necessary, under the conditions of these experiments, was found by means of tests with a thin-walled chamber made of goldbeater's skin. Needless to say, the dosimeter readings were not affected by the celluloid. After exposure, the eggs were incubated until all those still alive could hatch. The percentage of survival is the criterion of effect.

The calibration of the dosimeter in terms of the biologic dose was carried on in this way. Eggs were exposed to measured doses of radiation produced at various voltages from 220 to 900 kv. The percentage of survival was then compared with the survival rate, which follows the same doses of low voltage radiation. The data in Table I, taken from a large series, illustrate the method. In the first column of each section appear the doses measured by the dosimeter; in the second, the average percentage of survival of several samples of eggs exposed to these doses. In the third column are given the number of biologic or equivalent roentgens which experience has shown should produce the survival rates shown in Column 2. It is evident that when the voltage is 220 kv., the biologic and dosimetric measurements agree perfectly. The sums of the two columns showing the number of roentgens in the two cases are almost identical, but at 700 kv. the biologic effects are substantially less than was expected. The sum of the biologic roentgen doses is 81 per cent of the sum of the Victoreen doses. Many tests made with other voltages are summarized in Column 4 of Table II, and shown in Figure 1. In each case, filters appropriate to the voltages were used. It should be remarked, in passing, that by varying the filters, beams of equivalent wave length can be obtained over a wide range of voltages. It appears that with voltages from 400 to 900 kv., the half values ranging from 5.0 to 8.0, the biologic dose is about 80 per cent of the physical dose. The significance of this marked difference is not yet apparent; at this time all that can be said is that the intensity of x-ray beams produced at 400 kv. and higher, measured by the biologic method, is substantially lower than the intensity registered by the Victoreen dosimeter. It may be mentioned that the biologic measurements at these high voltages are in better agreement with preliminary measurements, made in this laboratory, with a graphite thimble chamber.

TABLE I.—ILLUSTRATING THE METHOD OF CALIBRATING THE VICTOREEN DOSIMETER BY BIOLOGICAL MEANS

220 kv. 0.25 mm. Cu plus 1 mm. Al			700 kv. 1 mm. Pb, 3 mm. Cu, plus 1 mm. Al		
Vict. r	Percentage Alive	Biol. r	Vict. r	Percentage Alive	Biol. r
110	79.7	115	115	86.8	98
158	61.0	161	175	68.3	143
176	57.4	170	232	52.3	184
205	47.9	196	279	38.1	227
220	37.4	229	326	29.1	263
869		871—100%	1,127		915—81%

In the measurement of surface doses the eggs are placed on a float made from gauze impregnated with beeswax. This is fastened to a wooden embroidery hoop and floated on the surface of a large water

phantom. As in the preceding experiment, the eggs are covered by a celluloid sheet. The intensity of the primary beam in air is measured, as usual, with the Victoreen dosimeter. To obtain the biologic intensity, the thimble chamber reading is multiplied by the factor shown in Column 4 of Table II, appropriate for the voltage used. For example, at 700 kv. the factor is 81 per cent. From the survival rate of the eggs, the biologic intensity at the surface can be calculated, and this, when divided by the biologic intensity of the primary beam, gives the percentage surface dose or surface intensity. The surface intensity has also been found without the aid of physical measurement in the following way. The eggs obtained during a two-hour collection period are divided into two lots. One lot is exposed in air, without scatter, for not more than six minutes. Then the other lot is placed on the surface of the phantom and exposed immediately for the same length of time. The biologic doses in the two tests can now be compared. The results of the two methods are alike, but the latter procedure is preferable, for, if the sensitivity of the eggs for any reason is different from usual, the same difference will obtain in both lots, and the ratio between the values will not be affected. Surface doses, measured under various voltages, are shown in Column 5 of Table II and in Figure 2. The data for the 120 kv. tests were obtained previously in experiments in which a different x-ray machine was used.

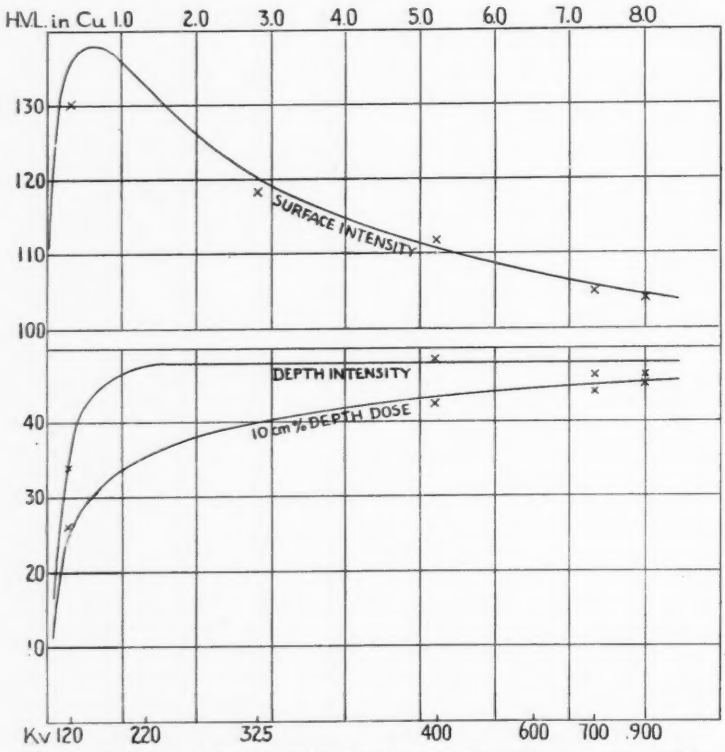

Fig. 2. Surface and depth intensities, and percentage depth doses, measured by biologic means. The portal area is 100 sq. cm. and the distance 70 cm. Except for the measurements at 120 kv., all experiments were made with the same x-ray machine.

The course of the curve shown in Figure

TABLE II.—VOLTAGES, FILTRATIONS, AND HALF VALUES IN CU USED IN THE PRESENT EXPERIMENTS; AND THE AVERAGED RESULTS OF MANY TESTS MADE TO CALIBRATE THE VICTOREEN DOSIMETER AGAINST A BIOLOGIC STANDARD, AND TO DETERMINE SURFACE AND DEPTH INTENSITIES IN A WATER PHANTOM BY BIOLOGIC MEANS

Kv.	Filter	H.V.L.	Percentage of Vict. Dose	Percentage Surface Intensity	Percentage Depth Intensity	Percentage Depth Dose
120	0.25 mm. Cu, 1 mm. Al	0.3	100	130	34	26
220	0.5 mm. Cu	1.3	100	...	...	...
325	0.25 mm. Sn	2.8	91	118	...	...
400	1 mm. Sn, 0.5 mm. Cu	5.2	83	112	49	43
600	0.5 mm. Pb, 3 mm. Cu, 1 mm. Al	6.5	82	...	...	...
700	1 mm. Pb, 3 mm. Cu, 1 mm. Al	7.3	81	105	47	44
900	2 mm. Pb, 3 mm. Cu, 1 mm. Al	8.0	80	104	46	45

2 indicates that the amount of back-scattered radiation rises rapidly to a maximum as the hardness of the beam increases to a point represented by a half value of somewhat less than 1.0 mm. of Cu. Thereafter it decreases with increasing hardness of beam. But as the voltage rises above 400 kv. (H.V.L. about 5.0) the decrease is not great. At 900 kv. the present measurements show a surface intensity of about 104 per cent of the primary beam. While exact comparisons with the results of other investigators are difficult to make, it may be said that the surface doses measured biologically are, in general, lower than those found by physical means. The curve, if continued to the right into the region of voltages higher than are shown in the figure, approaches the base line, indicating that the amount of back-scattered radiation is probably negligible.

The measurement of 10 cm. percentage depth doses involves the simultaneous exposure of eggs at the surface of the water phantom and at a depth. For submerging the eggs a bakelite container sealed with

TABLE III.—BIOLOGIC MEASUREMENT OF 10 CM. PERCENTAGE DEPTH DOSE

700 kv., 1 mm. Pb, 3 mm. Cu, 1 mm. Al, H.V.L. 7.3 mm. Cu, 100 sq. cm., 70 cm. distance

	Exp.	Percentage Alive	Biol. r	Biol. Int.	Percentage Depth Dose
10 cm.	10 min.	76.0	125	12.5 r/min.	43.7
Surface	10 min.	24.3	286	28.6 r/min.	

cellophane and beeswax is used. This has already been described elsewhere (3). The submersion of the eggs for periods up to 15 minutes produces no ill effects, provided the chambers contain not less than 1 c.c. of air. Our own tests have shown that if the volume of the chambers is less than this, it is necessary to keep a small current of air flowing over the eggs.

The results obtained by this method are illustrated by data from a single experiment, shown in Table III. The exposure was 10 minutes. The percentage of eggs surviving after irradiation at a depth of 10 cm. indicates that they received 125 biologic roentgens; at the surface the indicated dose is 286 roentgens. The intensity at each level is found by dividing these figures by the length of exposure. The percentage depth dose, found by dividing the depth intensity (12.5 r/min.) by the surface intensity (28.6 r/min.) is found to be 43.7 per cent. A summary of the tests made at the different voltages appears in Table II and in Figure 2. It is apparent from the course of the curve that increases in voltage above 900 kv. will not result in any great increase in the percentage depth dose. Indeed, the advantage of 900 kv. over 500 kv. is relatively slight in this respect.

It is difficult to make comparisons between the results obtained by different investigators who have measured surface and depth doses because the experiments have been made under widely different conditions of focal distance, portal area, and diaphragming. Furthermore, the quality of radiation is specified in various ways.

Sometimes only the filtration and distance are given; sometimes the half value in copper, or water, or aluminum is stated. Information that would permit the calculation of half values in any one of these absorbing media from data found in using the others is still far from complete. Until some standard experimental conditions are adopted by all investigators, comparison of results must be made with caution.

A more serious problem is met in the nature of the scattering medium. Water, whose absorbing and scattering properties are believed to resemble most closely those of tissue, is seldom used because of practical experimental difficulties. Wax or paraffin is far more convenient. Rice and pressed wood are also widely used for phantom materials, but experience shows that the magnitudes of surface and depth doses obtained from paraffin and rice vary greatly with the voltage. At 200 kv. wax gives readings at least 10 per cent higher than does rice (7) or a cadaver (5). At 1,000 kv., these two absorbers give practically identical results. Whether they agree with measurements in a water phantom is not known. In view of these disagreements it is evident that much further investigation must be made on the properties of these scattering media before they can be satisfactorily used in surface and depth dose measurements.

Although the absolute values of surface and depth intensities and percentage depth doses obtained by different observers vary considerably among themselves even when the experimental conditions are more or less alike, they all agree in certain characteristics. First, the surface intensities decrease in magnitude as the voltage increases. The rate of decrease is slight between 500 and 900 kv. Thus Phillips and Innes (4) using a wax phantom and a Siemens dosimeter show that at 500 kv. the surface dose is 111 per cent, while at 700 kv. (H.V.L. 7.0 mm. Cu) it is 109 per cent of the incident beam. Secondly, the depth intensities remain fairly constant over a wide range of qualities, showing little or no tendency to increase with increasing voltage. From this it follows that the percentage depth dose, which is calculated from the formula

$$\frac{\text{Depth intensity}}{\text{Surface intensity}} = \text{Percentage depth dose},$$

cannot increase to any marked extent since neither quantity in the fraction changes materially.

A practical application of these data is shown in Table IV in which are given the

TABLE IV.—TISSUE DOSES AT 10 CM. DEPTH (100 SQ. CM., 70 CM. DISTANCE) UNDER DIFFERENT QUALITIES OF RADIATION

H.V.L.	Percentage Depth Dose	Tissue Roentgens
1.0	34	170
2.0	38	190
3.0	40	200
4.0	42	210
5.0	43	215
6.0	44	220
7.0	45	225
8.0	46	230

actual doses in "tissue roentgens" delivered at a depth of 10 cm. under a portal of 100 sq. cm., the distance being 70 cm. The skin dose, including back-scattered radiation, is assumed to be 500 standard roentgens. In the first column appear the various qualities of radiation, designated by their half value layer in mm. of copper; in the second are the percentage depth doses for each of these qualities. The values are taken from the curve in Figure 2. The figures in Column 3 are obtained by multiplying the skin dose of 500 r by the various percentage depth doses. Thus they represent the doses in tissue roentgen at 10 cm. depth. From these figures it appears that when the half value of the beam increases from 5.0 to 8.0, representing an increase in voltage from about 400 to 900 kv., the augmentation in the dose is small, namely, 15 roentgens, or 3 per cent of the skin dose. The advantage of very high voltages, therefore, is very slight, if the criterion by which they are judged is the percentage depth dose or the amount of

radiation which can actually be delivered at 10 cm. depth.

REFERENCES

(1) EXNER, F. M., and PACKARD, C.: RADIOLOGY, **25,** 391–402, October, 1935.
(2) HENSHAW, P. S., and FRANCIS, D. S.: RADIOLOGY, **27,** 569–583, November, 1936.
(3) PACKARD, C.: RADIOLOGY, **29,** 12–21, July, 1937.
(4) PHILLIPS, R., and INNES, G. S.: British Jour. Radiol., **11,** 498–503, July, 1938.
(5) QUIMBY, E. H., and ARNESON, A. N.: Am. Jour. Roentgenol. and Rad. Ther., **37,** 93–97, January, 1937.
(6) SIEVERT, R. M.: Acta Radiol., **18,** 742–752, 1937.
(7) STONE, R. S., and AEBERSOLD, P. C.: RADIOLOGY, **29,** 296–304, September, 1937.
(8) TAYLOR, L. S., and SINGER, G.: our. Research, Nat. Bur. Stand., **21,** 19, 1938.

LATE SEQUELAE OF DIVERGENT BIOLOGIC SKIN EFFECTS PRODUCED BY ROENTGEN IRRADIATION WITH VARYING VOLTAGES[1]

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IN studying the influence of the irradiation with varying voltages on the biologic reaction of the skin, it is customary to pay attention only to the immediate effect which is best expressed in terms of skin erythema. A voluminous literature dealing with every phase of this subject has already appeared and since the advent of supervoltage roentgen therapy the investigations are being carried into the domain of exceedingly high voltages. It is now more or less generally acknowledged that the same degree of skin erythema may be obtained from increasingly greater physical doses when the irradiation is carried out with increasingly higher voltages. In this respect, an approximate co-ordination of the physical dose and the skin reaction exists up to about 1,200 kv.

More recently, however, evidence is accumulating, especially from the clinical side, that some sort of divergence is present also in the late effect, giving rise to certain sequelæ which cannot be ignored altogether.

LATE SKIN EFFECTS OF RADIATION

The late biologic effect of the radiation on the skin manifests itself in the form of atrophy, associated with a lesser or greater amount of telangiectasis. Obviously such change is best studied by histologic investigations. As a rule, there is a thinning out of the epithelial layer, with epilation due to destruction of the hair follicles. The connective tissue is fibrosed or hyalinized and the blood vessels are scanty and dilated. Although numerous publications describe *in extenso* the finest details of all these processes, the mechanism of their production continues to remain a subject of controversy. It would not further elucidate the problem to suggest that biologic experiments on simple or unicellular organisms may be drawn in for the purpose of comparative deduction.

Yet, in studying the late skin effect produced by roentgen irradiation with various voltages, one cannot escape the impression that the changes resulting from the harder rays are more supple and less exfoliative than those resulting from the softer rays. Microscopically, the predominance of hyalinization in the former and the increased granulation tissue activity in the latter may account to a certain extent for the different behavior. It may also help to explain the fact that the softer the radiation employed the greater the danger of necrosis some time after the initial irradiation and *vice versa*.

This variation of vulnerability of the tissues irradiated with different voltages is important also from another point of view. As is known, chronic ulcers of all types after a long period of time, and especially when secondarily infected, often undergo malignant degeneration. On one hand there occurs a keratinization of the epithelium followed by carcinomatous change and on the other an excessive proliferation of the connective tissue, giving lieu to true sarcoma. Indeed, there is ample proof that not a few of the chronic roentgen ulcers eventually are transformed into such malignant proliferative processes. But if a post-radiation atrophy, or telangiectasis of the skin, is more apt to lead to ulceration and necrosis when irradiation is carried out with softer roentgen rays than when hard, well filtered roentgen rays are used, then one may surmise that a degeneration into roentgen carcinoma or sarcoma is also more likely to occur in the former than in the latter instance. The purpose

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of the present article is to furnish clinical evidence that such is the case.

MATERIAL

A total of 28 cases of malignant roentgen neoplasms was observed in the Radiological Department of Harper Hospital during the period from 1922 to 1938, inclusive. Of these, three were sarcomas and the remaining carcinomas, all originating from the structures of over-irradiated skin areas.

The cases were referred for treatment because of their malignant condition. The over-irradiation which resulted from roentgen treatment given for some other lesion and which eventually led to the malignant degeneration of the skin had been carried out elsewhere, in most instances many years previous to the time the patients were seen by us. In securing the material for this article, an attempt was made to ascertain all data referring to the technic of procedure as well as the quality and dose of the irradiation which was used for the original treatment, but because of the long period which had elapsed between that time and the time the patients were referred to us, this was possible in only rare instances. A general idea could be obtained, however, as to the type of the roentgen rays used from the description obtained from the patients themselves as to the skin reaction which resulted from the irradiation. On this basis, a tabulation of the cases (Table I) was undertaken, and the available data so arranged that certain very definite conclusions could be drawn as to the dependence of the late skin sequelæ on the quality of the irradiation used.

Broadly, the cases may be placed in two groups: (1) those in which malignant degeneration of the skin resulted from occupation (these cases are not included in the table), and (2) those in which malignant roentgen neoplasms developed in skin areas treated previously for some other condition.

(1) The occupational cases included one radiologist, four industrial surgeons, and three dental surgeons. In all instances, the

TABLE I

No.	Case	Sex	Age	Condition Treated	Date Treatment	Type Roentgen Ther.	Dose	Date Late Skin Changes	Time of Ulceration or Keratosis	Malignant Degeneration Time	Malignant Degeneration Type	Treatment of Malignant Degeneration	Outcome
1	CG	M	35	Acne vulg., face	1913	Superficial	Unknown	1917	1924; K.	1926	Carc., temple	Deep roentgen-ray ther.; plastic operation	Died, 1931, from carcinoma
2	JM	F	15	Acne vulg., face	1914–18	Superficial	Unknown	1921	1927; K.	1928	Carc., nose	Radium ther.; plastic operation	Well
3	CG	F	29	Seb. dermat., forehead	1914	Superficial	Unknown	1916	1920; K.	1921	Carc., forehead	Radium ther.; multiple operations	Died, 1935, from carcinoma
4	WB	M	32	Keloid—burn of leg	1914–17	Unknown	Unknown	1917	1917; U.	1925	Carc., leg		Died, 1927, from carcinoma
5	JP	M	36	Acne vulg., face	1915	Superficial	Unknown	1919	1930; K.	1932	Carc., nose	Hypermassive roentgen-ray ther.; plastic oper.	Well
6	CC	M	20	Siccosis barbæ	1915	Superficial	2° erythema	1917	1932; U.	1933	Carc., lips	Plastic operation	Well
7	WL	F	50	Psoriasis	1918–21	Superficial	Unknown	1922	1923; U.	1924	Carc., back	Excision	Unknown
8	FK	F	—	Uterine fibroid	1918–21	Medium	Unknown	1921	1922; U.	1925	Carc., abd. wall		Died, 1927
9	HB	F	3	Thymic enlargem.	1919	Unknown	Unknown	Unknown	1932; K.	1932	Sarcoma, sternal reg.	Radical operation; supervolt. roentgen ther.	Died, 1938, from sarcoma
10	ML	F	28	TB. peritonitis	1919–21	Medium	Unknown	1923	1930; U.	1932	Carc., abd. wall	Operation	Well
11	FM	F	48	Post-op. carc. breast	1919–20	Medium	3° erythema	1921	1922; U.	1922	Carc., chest wall	Deep+hypermassive roentgen ther.	Died, 1937, carc. metastases
12	FM	F	35	Toxic goiter	1920–21	120 kv., 4 mm. Al	30 treatm.		1927; K.	1936	Carc., neck	Plastic operation	Well
13	AY	F	30	Pruritus vulvæ	1920–21	Superficial	Unknown	1923	1930; U.	1931	Carc., labium majus	Excision	Well
14	AW	F	20	Toxic goiter	1920–21	125 kv., 4 mm. Al	35 treatm.	1922	1925; K.	1926	Carc., neck	Excision	Well
15	JR	M	25	TB. cervical adenitis	1922–23	120 kv., 4 mm. Al	2° erythema	1925	1936; K.	1937	Keratosis		Well
16	WB	M	36	Carcinoma, bladder	1923–25	200 kv., 1 mm. Cu	6 series of 100%	1925	1930; suprapub. for recurrence	1931	Sarcoma in wound	Excision	Died, 1931, carc. bl a d.; sarc. wound
17	AL	F	17	Superfluous hair, chest, forearms	1924–25	Tryco	45 treatm.	1927	1936; U. and K.	1936	Carc., nose, chest	Plastic operation	Well
18	HR	M	50	Callus sole	1925	85 kv., unfilt.	3° erythema	—		1937			
19	WS	M	58	Keratosis, forehead	1926	Superficial	3° erythema	1927	1927; U.	1929	Carc., sole	Excision	Well
20	NH	M	41	Ringworm, foot	1929	70 kv., unfilt.	3° erythema	—	1929; U.	1931	Carc., forehead	Radical operation; roentgen ther.	Died, 1932, from carcinoma
										1931	Sarcoma, foot	Amputation of foot; deep roentgen ther.	Well

roentgen changes were localized to the hands. They consisted of marked atrophy, intermingled in places with pronounced telangiectasis and later hyperkeratinization, ulceration, and carcinomatous degeneration of the skin. In the case of the radiologist, they were acquired mostly as a result of excessive fluoroscopic work, in the industrial surgeons from insufficient protection during reduction of fractures under fluoroscopic control, and in the dental surgeons from the rather unusual habit of holding the films in the patients' mouths with their own fingers while making roentgenograms of the teeth. In these latter, the changes always occurred on the index finger—in one case on both sides—and they were so severe that exarticulation of the affected finger had to be performed.

The results of the treatment in all eight cases of occupational involvement were—at least for the time being—good. Following surgery, electrocoagulation, hypermassive roentgen therapy, or radium application, used singularly or in multiple combination, a full control of the process has been brought about and the patients are continuing to pursue their usual occupations without trouble, though on the basis of added experience, with considerably greater care.

(2) The cases in which roentgen changes occurred as a result of over-irradiation for some other condition comprise a rather varied group (Table I). In three cases, the original irradiation was done for the treatment of acne vulgaris of the face; in one for siccosis barbæ; in one for seborrheic dermatitis of the forehead; in two for ringworm or callus of the foot; in one for removal of superfluous hair of the face, chest, and forearms; in two for toxic goiter; in one for tuberculous cervical lymphadenitis; in one for tuberculous peritonitis; in one for pruritus vulvæ; in one for uterine fibroids; in one for thymic enlargement, and in five for other lesions.

The treatment of the malignant degenerative processes in this group led to only fair results. Eight cases died within from one to fifteen years following the first sign of malignant transformation, one case remained untraced, and eleven cases have apparently been controlled or temporarily arrested. In the cases of the patients who died, exitus followed as a rule from generalization of the malignant process—in six from carcinoma, and in two from sarcoma.

DISCUSSION

In analyzing the causes, especially as they concern the dosage and type of radiation used in the above cases, it again appears advisable to draw a line of distinction between the two groups.

(1) In the first group, the roentgen ray acted as a continuous irritating agent for many years. At shorter or longer intervals, during the course of professional exercise, repeated doses of radiation reached the surface of the skin which then, through cumulation over a period of time, led to sequelæ, eventually giving lieu to malignant degeneration. The nature of such changes is now well understood and no further mention need be made. The quality of the roentgen rays in all these instances was that usually employed in fluoroscopic work, that is, corresponding to about 30–80 kv.

(2) In the second group, large doses were given from the beginning but a certain radiation-free period has occurred between the completion of the series of irradiation for the original lesion and the appearance of the first sign of malignant degeneration of the skin. The average lapse of time for the 20 cases was eight years, two years being the shortest and 18 years the longest interval. Thus it appears that, once an overdose, either in the form of a single large dose or of repeated smaller doses, is administered over a certain skin area, the changes produced become permanent and the cessation of irradiation does not preclude a malignant degeneration at any time later. As contributory factors, one may consider ulceration due to direct injury, crevasse formation from over-stretching, secondary infection, and perhaps a more rapidly progressive senile degeneration of the skin. Es-

pecially the badly infected denudations of long duration are almost certain to give rise to malignant proliferative processes.

The quality of the radiation employed, in this group, was as follows: in 11 cases superficial roentgen therapy (50–100 kv., mostly unfiltered); in six, medium roentgen therapy (100–130 kv., 1–5 mm. Al), and in two cases the type of radiation was unknown. During the same period, a total of more than 10,000 cases were treated in our department for various lesions with deep roentgen therapy (200 kv., 1 mm. Cu), and for the last six years also with supervoltage roentgen therapy (600 kv., 7 mm. Cu), and not one single case of malignant roentgen degeneration was noted, although in about 10 per cent of the patients alive, a marked atrophy and even a telangiectasis of the skin resulted from the irradiation. In one case (Case 16 of Table I) in which six series of deep roentgen therapy given for a carcinoma of the bladder produced a marked atrophy and telangiectasis of the skin of the lower anterior abdominal wall, most probably from the continuous irritation, a roentgen sarcoma developed in a cystotomy wound about a year after the bladder was opened, although for seven years previously no degenerative process had been noticed.

The above data, thus, seem to indicate that superficial or even medium roentgen therapy, when used in large doses, is apt to lead to severe late skin changes which may degenerate into carcinoma or sarcoma. Deep roentgen therapy produces a more supple effect on the skin and although late changes may occur, a transformation into malignant degeneration is observed rarely. Supervoltage roentgen therapy permits irradiation with the least damage to the skin and, therefore, one may surmise that the danger of late sequelæ may entirely be dismissed. It must be mentioned, however, that this article does not refer to the very heroic form of protracted irradiation, with either deep or supervoltage roentgen rays, in which excessive cumulative doses are used. It is quite conceivable that in such instances severe ulcerations of the skin, when failing to heal or when healing only temporarily, should, because of the continuous irritation, eventually lead to malignant proliferative processes.

CONCLUSIONS

(1) Permanent skin changes resulting in late sequelæ, such as chronic ulceration or malignant degeneration, must be obviated inr adiation therapy as much as possible.

(2) Whenever technically feasible, preference should be given to the harder roentgen rays, for with increasing voltages an increasingly greater physical dose can be administered to obtain the same degree of cutaneous reaction. This, then, permits the treatment of the underlying lesion with less damage to the skin. Moreover, because of the greater depth dose inherent on the higher voltages, the surface dose *per se* can be further reduced to obtain the same therapeutic efficacy.

(3) For the above reasons, superficial roentgen therapy in dermatologic conditions is best carried out with the upper limit of the voltage range and some sort of filtration whenever possible. The medium roentgen therapy in certain lesions (tuberculous lymphadenitis, toxic goiter, benign gynecologic bleedings, etc.) may entirely be replaced by deep roentgen therapy. Finally, supervoltage roentgen therapy will prove of decided advantage over deep roentgen therapy in protecting the skin and normal structures in cases in which large depth doses and long irradiation periods are required.

CLINICAL ASPECTS OF SUPERVOLTAGE ROENTGEN THERAPY IN CANCER[1]

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From the Oncological Service of Drs. Soiland, Costolow, and Meland

THE supervoltage apparatus used by our group since 1933 has been described on several previous occasions. Essentially, the tube is a copy of one built by Professor C. C. Lauritsen at the California Institute of Technology. The valve tube transformer circuit is of the Villard type. The voltage used is 525 to 550 kv. The focal skin distance is 52 cm. and the filtration equivalent to 0.8 mm. lead (half value layer 0.56 mm. lead and 2.8 cm. aluminum). The current through the tube is approximately 3.2 ma., the output being 15 r per minute. The effective wave length is 0.044 Ångstrom (Fig. 1).

In the treatment of deep-seated malignancies, it has been shown in the past that, as voltages have been increased, the five-year cures have been increased. Changing from 130 to 140 kv. to 200 kv. was a definite advance. With the advent of supervoltages, in the realm of 500 kv. or more, it was hoped that results would be markedly improved, as absorption of greater intensities in the depths might be expected. It was thought that larger total dosages might be administered, as there would be less skin injury with the supervoltages, due to a decrease in back-scatter and an increase in forward-scatter.

A comparison between patients treated in the past with 200 kv. and those treated with supervoltage in more recent years, is almost impossible because other factors beside voltage have been variable. The mode of application of roentgen therapy, fractionation of dosage, time factor of individual applications, and total elapsed time of the entire series have all been altered. These are all very important factors and each may be just as important as the factor of voltage.

A description of some of the various lesions treated by means of supervoltage will be given.

Carcinoma of the Inner Surface of the Cheek.—This is usually of low grade malignancy and quite resistant to irradiation. We selected a few specimen cases of these conditions for treatment by fractionated supervoltage alone. As these lesions were rather near the surface, adequate dosage could have been secured by lower voltages. The tumor in these cases received about 80 per cent of the surface dosage (as measured by the Lauritsen chamber).

Table I shows the method of treatment in these cases, with dosage and results.

We realize that fractionated dosage with the ordinary 200 kv. might have accomplished the same result with proper filtration and prolongation of dosage (although, personally, we have never been able to secure similar regressions with 200 kv.). The total dosage of supervoltage in these patients was not large. The majority received a total of about 3,000 r (air), given at the rate of 150 r daily. In some cases the treatment was completed without definite erythema. In none of these cases have there been any late skin changes, telangiectasia or fibrosis, and, in all, the texture of the skin at the present time appears perfectly normal.

Carcinoma of the Esophagus.—Our results with supervoltage in carcinoma of the esophagus have been extremely disappointing, the majority of the patients not having lived longer than six months following treatment. Definite palliation was secured in only about one-third of those treated. Two cases showed complete regression of the local growth (in one case this

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

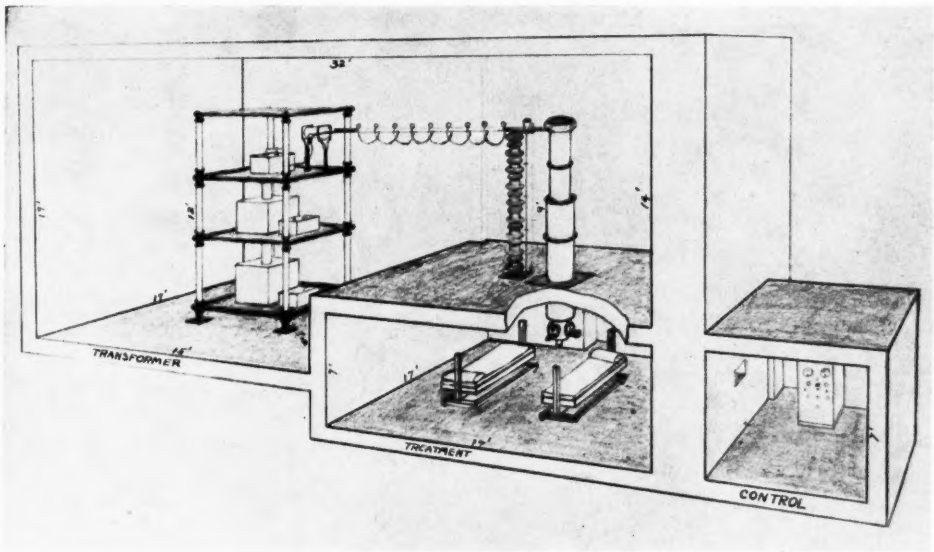

Fig. 1.

was proved by autopsy), but both died of liver metastasis.

Cases of carcinoma of the esophagus are almost always in an advanced stage when first diagnosed, and usually distant metastasis has already taken place. Our patients were given fractionated irradiation by means of supervoltage, the dosage in many cases being to the limit of skin tolerance. Supervoltage results have not been superior to those obtained by the ordinary high voltage. The cures from irradiation in this condition are probably *nil*, but this does not mean that irradiation is not indicated in many of these cases, because undoubtedly there is marked temporary palliation.

Carcinoma of the Bladder.—We have not been greatly encouraged by the results obtained in carcinoma of the bladder. Twenty-one patients were treated by means of supervoltage alone, nearly all of whom were advanced to the extent that surgical methods of treatment or radon implantation were not considered. The results are shown in Table II.

TABLE I.—CARCINOMA OF THE CHEEK

Case	Pathology	Diagnosis and Stage	S.V. Areas 10 × 10	Result
I	S C 1	1.5 × 2 cm., lower part inner surface cheek	300 r daily Total 2,250 r	Well 3 yrs. 5 mos.
II	S C 1	Covering entire inner surface from angle of mouth to angle of jaw; glands	300 r daily Total 2,850 r	Well 3 yrs. 6 mos.
III	S C 2	2 × 2 cm.	150 r daily Total 3,000 r	Well 8 mos.
IV	S C 2	Extensive, with perforation of cheek	150 r daily Total 3,100 r	Well 1 yr. 5 mos.
V	S C 1	2 × 3 × ' cm. thick, involving alveolar margin	150 r daily Total 3,000 r	Well 1 yr.
VI	S C 4	2 cm. wide, involving gum	150 r daily Total 3,750 r	Well 1 yr. 5 mos.
VII	S C 2	Ulceration and infiltration of entire rt. inner cheek	150 r daily Total 3,000 r	Well 1 yr. 9 mos.
VIII	S C 1	1 × 1.5 cm., middle inner surface cheek	150 r daily Total 3,000 r	Well 1 yr. 4 mos.

TABLE II.—CARCINOMA OF THE BLADDER, 21 CASES

Year	No. Cases	Dead	Living with Disease	Free from Disease
1933	1			1
1934	6	5		1
1935	3	2		1
1936	4	4		
1937	7	3	1	3
Total	21	14	1	6

Practically all of these cases showed some degree of palliation, such as checking of hemorrhage and appreciable regression of the tumor. Some of the patients had complete regression of the tumor, but died later from recurrence or metastasis. While our results of regression and palliation from supervoltage have been somewhat encouraging in our advanced cases, we realize that in a larger group of cases Ferguson has obtained better results by means of high voltage irradiation, using larger distances with heavy filtration.

Carcinoma of the Prostate.—It is undoubtedly possible to obtain considerable palliation by means of high voltage (200 kv.) x-ray therapy in carcinoma of the prostate. The bleeding is often checked and a large number of patients find relief from the pain caused by bone metastasis. However, definite reduction in the size of the nodular infiltration of the carcinomatous process has not been a constant finding.

Twelve cases of advanced carcinoma of the prostate, in which previous urethral resection had been done, were treated with fractionated supervoltage technic. Six or eight pelvic portals were used with a technic and total dosage similar to that used in carcinoma of the cervix (which will be described later). Of the twelve cases, nine showed marked regression in the nodular infiltration and size of the involved prostate. Two cases showed complete regression of the growth as far as could be determined by palpation. Probably there will not be any cures obtained in any of these patients, yet the palliation has been marked and definite. We believe this regression obtained by means of supervoltage is more certain and definite than has been reported from the use of any 200 kv. technic.

Technic of Treatment in Carcinoma of the Cervix.—The treatment of carcinoma of the cervix by means of supervoltage must be individualized, as is the case when any other technic is used. The patient is measured and the number and size of the portals decided upon. Ordinarily, two 10 × 15 cm. or 15 × 15 cm. portals are used anteriorly and four 10 × 10 cm. portals are used posteriorly (two sacral and two perineal portals). For a time two 10 × 10 cm. lateral portals were used, but these have been discontinued. Treatments are given daily, 150 r being administered to two or three portals. Often the daily dose is decreased or increased for a while, depending upon the condition of the patient and the development of nausea, diarrhea, or other symptoms. The treatments are frequently discontinued for a few days. We believe that if the patients are not observed closely, the general condition may be greatly impaired and the regression of the local growth definitely retarded. The treatment is often continued for from 40 to 45 days or longer. Each skin portal may receive from 1,800 to 2,000 r (air) or more.

In the series of cases of carcinoma of the cervix which we have treated by means of supervoltage, the measured tumor dosages in the mid-pelvis were between 2,000 r and 4,000 r. In some cases the tumor dosage of 4,000 r was exceeded in the initial series. If the dosage was in excess of 4,000 r, often quite marked bladder and intestinal reactions (both early and late) occurred.

Frequently radium treatment is commenced during the supervoltage series or immediately after its completion. In this manner the radium series is completed before any definite fibrosis of the vaginal walls or vault occurs. Also a prolonged irradiation reaction period on the malignant tissue is obtained.

The radium is applied in three séances, usually of from 2,000 to 2,500 milligram-hours each. One-half of the amount is

usually applied intra-uterine and one-half in the vaginal fornices. The intra-uterine radium is filtered by 0.5 mm. silver, 1 mm. gold, 1 mm. aluminum, and 1 mm. hard rubber. The filtration of the vaginal applicator is the same except that 2 mm. of gold are used. The second séance is one week after the first and the third séance is two weeks after the second.

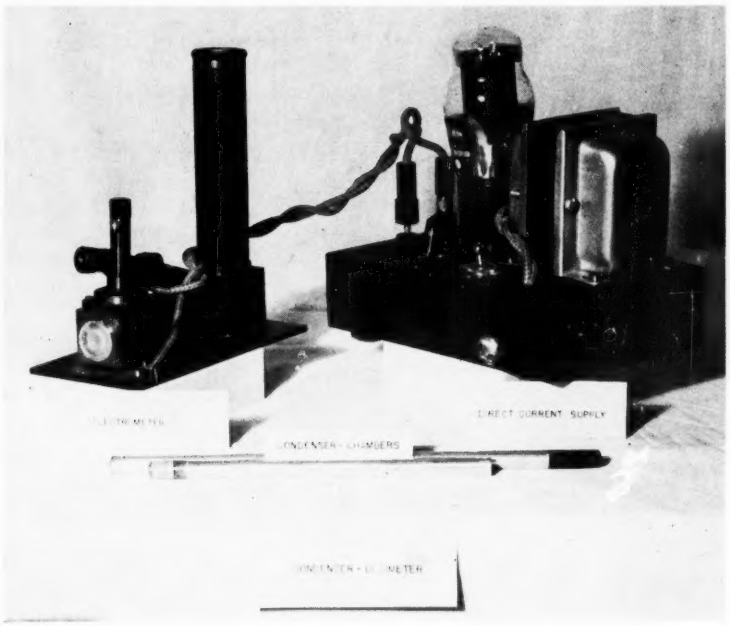

Fig. 2.

Measurement of Tumor Dosage.—The measurement of the tumor dose has been accomplished for some time in our clinic by means of two small ionization chambers built by Thomas Lauritsen of the California Institute of Technology (Fig. 2). One chamber is placed on the skin surface in the center of the portal and the other against or alongside of the cervix. These chambers remain in position during the treatment.

Portals 1, 2, 3, and 4, 10 × 15 cm. in size (Fig. 3, with the chambers in position), are direct anterior and posterior portals through the pelvis. The perineal Portals 5 and 6, 10 × 10 cm. in size, are obtained by placing the patient in position with the thighs flexed. The beams through these

Fig. 3.

portals diverge slightly toward the cervix and consequently the depth doses at the cervix are higher than those of the other portals, where the cervix is in the edge of the direct beam. The use of the small ionization chambers in measuring the intensity of the radiation in the neighborhood of the cervix affords an opportunity to determine the accuracy with which the patient is placed with reference to the radiation beam. This is a valuable check when multiple portals are used.

TABLE III.—CARCINOMA OF THE CERVIX, 1933, 5-YEAR CASES

Stage	No. Cases	Dead	Alive with Disease	Free from Disease
I	0	0	0	0
II	5	2	1	2 (40%)
III	12	11	0	1 (9%)
IV	11	11	0	0 (0%)
Total	28	24 (86%)	1 (3%)	3 (11%)

TABLE IV.—CARCINOMA OF THE CERVIX, 1934, 4-YEAR CASES

Stage	No. Cases	Dead	Alive with Disease	Free from Disease
I	0	0	0	0
II	7	4	0	3 (43%)
III	9	7	0	2 (22%)
IV	10	10	0	0 (0%)
Total	26	21 (81%)	0 (0%)	5 (19%)

Carcinoma of the Cervix Uteri.—Supervoltage has been used by us in the treatment of carcinoma of the cervix uteri more consistently than in any other condition. Cervical carcinoma affords a better opportunity to evaluate supervoltage than any other type of cancer, because these patients can be easily classified and the extent of the disease quite definitely determined by palpation. In our cases the classifica-

TABLE V.—CARCINOMA OF THE CERVIX, 1935, 3-YEAR CASES

Stage	No. Cases	Dead	Alive with Disease	Free from Disease
I	1	0	0	1 (100%)
II	8	1	0	7 (88%)
III	7	2	0	5 (71%)
IV	9	7	1	1 (11%)
Total	25	10 (40%)	1 (4%)	14 (56%)

TABLE VI.—CARCINOMA OF THE CERVIX, 1936, 2-YEAR CASES

Stage	No. Cases	Dead	Alive with Disease	Free from Disease
I	3	0	0	3 (100%)
II	12	0	0	12 (100%)
III	32	9	3	20 (62%)
IV	10	9	0	1 (10%)
Total	57	18 (32%)	3 (5%)	36 (63%)

TABLE VII.—CARCINOMA OF THE CERVIX, 1937, 1-YEAR CASES

Stage	No. Cases	Dead	Alive with Disease	Free from Disease
I	2	0	0	2 (100%)
II	13	0	1	12 (92%)
III	17	1	8	8 (47%)
IV	10	5	2	3 (30%)
Total	42	6 (14%)	11 (26%)	25 (60%)

TABLE VIII.—CARCINOMA OF THE CERVIX: TOTAL NUMBER OF CASES WELL (83)

No. Yrs. Well	5 Yrs.	4 Yrs.	3 Yrs.	2 Yrs.	1 Yr.
Stage I	0	0	1 (7%)	3 (8%)	2 (8%)
Stage II	2 (67%)	3 (60%)	7 (50%)	12 (33%)	12 (48%)
Stage III	1 (33%)	2 (40%)	5 (36%)	20 (56%)	8 (33%)
Stage IV	0	0	1 (7%)	1 (3%)	3 (12%)
Total cases	3	5	14	36	25

TABLE IX.—RESULTS OF SUPERVOLTAGE IN 178 CASES OF CARCINOMA OF THE CERVIX

Stage	No. Cases	Dead	Living with Disease	Free from Disease	Percentage Free from Disease
I	6	0	0	6	100%
II	45	7	2	36	80%
III	77	30	11	36	48%
IV	50	42	3	5	10%
Total	178	79 (44%)	16 (9%)	83	47%

Stages I and II, 51 cases, 29 per cent. Stages III and IV, 127 cases, 71 per cent.

tion of the disease was the Schmitz grouping of four stages of involvement.

During the period 1933 to 1937, inclusive, 178 patients with primary carcinoma of the cervix were treated with a complete course of supervoltage therapy and additional radium. This group of 178 patients received complete treatment which will be outlined later. All other cases in which either radium combined with high voltage roentgen therapy or radium alone, or other modified treatment was administered, have been excluded (Tables III–IX).

The groups of patients treated four and five years ago by means of supervoltage are quite small, and it is doubtful if much information of value can be obtained by analyzing them. The material was advanced (71 per cent in Stages III and IV) in the five-year group. Certainly, the four- and five-year curative results have not been any better than those obtained in the past with high voltage and radium.[2] However, the present supervoltage group is too small to afford a fair comparison.

As previously stated, the factors of time and interval of individual applications, and total dosage, have all been altered since the advent of supervoltage. These factors may be equally as important as the factor of increased voltage.

Palliation and primary regression have been definitely improved since the introduction of supervoltage. During the past three years complete disappearance of pelvic gland pathology has occurred in 11, 10, and 30 per cent, respectively, of Group IV cases, and in 71, 62, and 47 per cent, respectively, of Group III cases.

In our previous experience in the treatment of 1,143 cases of carcinoma of the cervix by means of radium alone or radium with 200 kv. roentgen therapy, in only two Stage IV cases did we see the complete disappearance of all pelvic gland pathology.

[2] Not so good as the five-year results in a larger group of cases published by us (RADIOLOGY, **26,** 193–197, February, 1936).

THE REACTION OF CARCINOMAS OF THE CERVIX TO KNOWN DOSES OF 800 Kv. ROENTGEN RAYS: THE FIVE-, FOUR-, AND THREE-YEAR SURVIVAL RATES[1]

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THE part assigned to me by your chairman in this symposium is a report on the clinical observations made in carcinomas treated with 800 kv. roentgen rays.

The clinical observations should comprise:

(1) The technic, including the factors used in the production of the roentgen ray, especially the half value layer. These determine the quality.

(2) The output of r per minute.

(3) The approximate distribution of the radiation intensities as the beam traverses the tumor, by determining the equal intensity curves or isodoses.

(4) The method of application of the radiation dose, which should consider the spacing and time duration of each fraction.

(5) The action of the roentgen rays on the tumor and carcinoma cells.

(6) The five-year good end-results or survival rates.

The final proof of the adequacy of the treatment consists of the disappearance of the tumor, the degeneration or destruction occurring in the cancer cells, and the survival rate at stated time intervals, usually five years. The factors of x-ray production, the distribution of radiation intensities within the tissues traversed by the roentgen-ray beam, the method of treatment, and the clinical grouping according to the extent of the tumor have been reported in earlier communications and will not be discussed here (1).

This report will be confined to the clinical observations made in carcinomas of the uterine cervix, namely, the action of the 800 kv. roentgen rays on the tumor and on the carcinoma cells with known radiation doses, and the survival rates after three, four, and five years.

The local reactions in the carcinomatous cervix caused by the application of 800 kv. maximum roentgen rays are: (1) hyperemia and a capillary injection of the surface mucosa surrounding the cancer on about the seventh to the fourteenth day, corresponding to radiation tumor doses of approximately 1,125 to 2,250 r with backscatter; (2) the formation of a whitish fibrinous or pseudo-membrane over the mucosa and a flattening out of the carcinomatous ulceration within the next two weeks, corresponding to a local dose of approximately 3,375 to 4,500 r with backscatter; (3) followed by a blackish green discoloration of the crater or ulcerative part of the growth, and during the sixth to eighth week the necrotic area is replaced by granulation tissue and ultimately by epithelization. In unfavorable cases, friable granulation tissue may persist. A biopsy alone can tell us whether the friable tissue means necrosis or continuation of the cancer disease. If cancer cells are not found, then the radiation ulcer is treated expectantly and, ultimately, healing may ensue. Should carcinoma be found, then one must assume that the radiation dose had been inadequate or recurrence had taken place. We, then, prefer to use radium filtered with 2 mm. lead and 1 mm. aluminum or with 1.5 mm. platinum. The treatments are given in three fractions, eight days apart. The dose of each fraction is approximately 1,500 to 1,800 milligram element hours. The reason we do not increase the roentgen-ray dose is the danger of producing a Grade 3 skin reaction, which means a wet dermatitis with concomitant changes in the vesical, rectal,

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

[2] Dr. Schmitz' death occurred on April 17, 1939.

and vaginal mucosæ. The addition of gamma rays applied intracavitary within the cervical canal causes, of course, an intensification of the local or tumor reaction. However, destructive tissue reactions have so far not been observed.

The changes occurring in carcinoma cells were studied on 25 consecutive cases. The same radiation intensities were applied approximately throughout. Tissue for microscopic studies was removed before the beginning of treatment and whenever tumor doses of approximately 1,125, 2,250, 3,375, and 4,500 r with back-scatter were attained, and thereafter within eight to twelve weeks. If epithelization or healing had occurred, the cancer was deemed to be arrested; if granulation or friable tissue persisted, then biopsy would enable us to differentiate between benign ulceration free from admixture of cancer cells or persistence and recurrence of the carcinoma.

The microscopic changes appear to run according to a definable and orderly sequence, coinciding with the radiation dose applied to the tumor area.

Fourteen cases were free of any critical objections and eleven cases had to be excluded on account of lack of co-operation on the part of the patient or on account of the inaccuracy of the primary microscopic diagnosis. The remaining 14 cases showed:

Transitional-cell types	9
Spinal-cell types with cornification	3
Spindle-cell type	1
Adenocarcinoma	1

The various forms of cell degeneration will not be described, as they correspond to those seen during radium and 200 kv. roentgen treatment. The degenerations differ, depending on the method of irradiation, namely, the single massive dose, the spaced dose with high loads on tube, hence short time treatments, and the spaced doses with long time outflow. Fractionation with time intervals between alternating treatments of from 48 to 72 hours and high r per minute outflow are used in the Institute, the r per minute flow being 36 without back-scatter or 44 with back-scatter, to which should be added the exit dose from the opposite field, which is about 18 per cent of the surface or entrance dose. It appeared that the reactions of cells with little or no tendency to cornification and of those with cornification differed. The non-cornifying carcinoma cells under the influence of increasing doses of radiation have a tendency to assume either of two forms: (1) markedly swollen cells with palely basophilic cytoplasm, with karyolysis of the nuclei; (2) large, even giant cells with giant hyperchromatic nuclei and dense eosinophilic cytoplasm. They may be referred to as the *large pale basophilic type* and the *large eosinophilic type*.

The cornifying carcinoma cells assume two main forms: (1) small cells with bright red intracytoplasmic masses and small, compressed, pyknotic, single nuclei, and (2) larger cornified plates.

Our biopsy material included only the superficial portions of the tumors close to the surface necrosis. Furthermore, the changes in every tumor were not as uniform as the summary might indicate. In one case a definite deviation was noted in a biopsy specimen taken at the end of the third week of therapy. Near the necrotic surface the large eosinophilic type predominated; about one millimeter deeper the large palely basophilic type was in the ascendancy. Two millimeters deeper, tumor resembling that in the pre-treatment biopsy and showing but little radiation effect was noted.

Many of the cases included in this investigation were followed by biopsy for several months after the completion of treatment. In four cases no tumor was noted even thirteen weeks after cessation of therapy. In two of these the tumor had disappeared by the end of the second week of roentgen-ray therapy. In other cases the tumor persisted and the previously listed effects of radiation on tumor cells were noted as long as five weeks after the completion of treatment, but no definite recurrence was in evidence. Seven cases, however, did show definite recurrence, in some instances as early as two weeks after completion of therapy. The reappearing tumor showed

the features of the pre-treatment biopsy. No radiation effects were present. These cases were subsequently subjected to radium therapy.

The one adenocarcinoma of the cervix in this series of cases was of the mucous gland type. The changes in the cells included those listed above for Group I cells, but were milder in degree. Swelling of cells and nuclei, the disappearance of cell boundaries, the appearance of eosinophilic cells with large pyknotic nuclei and paler cells showing some karyolysis, and finally the complete loss of much of the epithelial lining of the gland spaces were noted. The few remaining cells were notably damaged. The mucus in the gland spaces seemed to become denser as radiation therapy continued.

No definite sequence was noted in the changes in the fibromuscular tissues of the cervix nor in the non-cancerous cervical epithelium. Swelling of collagen, most marked around capillaries or in walls of arterioles, was noted by the end of the first week of therapy. The changes in the subendothelial tissues in the walls of small arteries were most pronounced by the end of the third week, although noted as early as the end of the first week. These changes were not particularly severe. Edema and vesiculation of the epithelium were also noted by the end of the first week, but were not a constant feature.

No prognostic significance could be attached to the presence of numerous eosinophiles in the inflammatory exudate in the tumors included in this series. In two cases, in which their presence was a rather prominent feature, the carcinoma had disappeared by the end of the second week of therapy. However, in some cases in which the carcinoma persisted or recurred, eosinophiles were also in evidence, particularly in one case in which recurrence and even invasion of the broad ligaments were noted shortly after completion of therapy.

The absolute disappearance of carcinoma was found in four cases (30 per cent); degenerated tumor cells were found in three cases (20 per cent), and definite recurrence after a primary disappearance was observed in seven cases (50 per cent). The number of primary cervical carcinomas treated with the 800 kv. roentgen technic was as follows: 17 cases in 1933; 27 cases in 1934, and 28 cases in 1935.

During this same period 81 recurrent carcinomas were seen. Twenty-six primary carcinomas were treated with the 200 kv. roentgen and radium technic. The primary cases enumerated above are grouped in the four clinical groups and the survival rates at five, four, and three years are given.

TABLE I.—SURVIVAL RATES IN UTERINE CARCINOMAS

Clinical Group	I	II	III	IV	Total
(*a*) Five Years					
Number treated	2	1	6	8	17
Number well	2	1	4	2	9
Percentage well					52.93
(*b*) Four Years					
Number treated	2	2	9	17	30
Number well	2	2	9	4	17
Percentage well					56.67
(*c*) Three Years					
Number treated	3	7	17	19	46
Number well	3	7	17	4	31
Percentage well					67.56

If these survival rates are compared with those obtained with 200 kv. roentgen-ray and gamma-ray treatment, then it is apparent that the survival rates are better with the supervoltage technic.

The number of cases is very small, yet it gives an approximate idea of the efficacy of supervoltage radiation therapy in the region of 800 kv. It will take years to accumulate a large number of cases treated with a given technic. It is obvious that with a technic in which many fields are used, and the dose applied to each field is the so-called *tolerance dose*, the summarized doses in the mid-pelvis are much higher than those used in this report. The differences in technic would prohibit a comparison of results.

CONCLUSIONS

The action of 800 kv. x-rays in carcinomas of the cervix has been studied in 14 cases treated with fraction tumor doses of about 400 r, with back-scatter, repeated

ten times. In four cases the carcinoma had disappeared at the end of treatment, while in three degeneration of cancer cells was complete, and in seven the carcinoma had assumed renewed activity after a primary marked degeneration of growth. These seven cases were given an additional treatment with radium.

The survival rates for five, four, and three years have been given. It is obvious that these rates are markedly higher than those obtained with other methods of radiation therapy.

REFERENCES

(1) SCHMITZ, HENRY, SCHMITZ, HERBERT E., and SHEEHAN, J. F.: Action of Measured Doses of 800 Kilovolt Roentgen Rays on Carcinoma of Uterine Cervix. Jour. Am. Med. Assn., **112,** 17–22, Jan. 7, 1939.

(2) Idem: Clinical Observations on the Treatment of Primary Carcinomas of the Cervix with 800 Kilovolt Roentgen Rays. Am. Jour. Obst. and Gynec., **35,** 405–417, March, 1938.

DISCUSSION OF SYMPOSIUM ON THE DIFFERENCES BETWEEN 200 KILOVOLT AND SUPERVOLTAGE ROENTGEN THERAPY

DR. OTTO GLASSER (Cleveland, Ohio): During the last year we have heard a number of interesting papers on supervoltage therapy. We have now arrived at a period of supervoltage therapy in which there is a definite demand for accurate statements in regard to the comparisons of this kind of therapy with the old-fashioned 200 kv. therapy, and I think we should all be glad that this has been the subject of to-day's Symposium. I think that Dr. Corrigan's paper to-day has taught us how to approach the subject from the physical point of view. He has not only determined depth doses experimentally but he has also chosen those factors which are different for supervoltage and for 200 kv., such as back-scattering, forward-scattering, and has calculated from them the depth dose. Both agree quite satisfactorily.

There are many questions which I could ask, but I will ask only one or two. I was interested in Dr. Packard's statement that he used a sheet of almost one millimeter of celluloid on top of his *Drosophila* eggs. It would be interesting to know just why he used that particular thickness and how it would influence measurement with the thimble chamber.

Then I would like to ask Dr. Costolow how the measurements made with his large and small chambers compare with the Victoreen thimble chamber.

DR. PAUL S. HENSHAW (New York City): It seems particularly significant that a group composed largely of clinical radiologists should be interested in the action of different kinds of radiation on *Drosophila* eggs. Surely this is a frank admission that a completely satisfactory answer to the question of wave length has not been obtained in the clinic and recognition of the idea that simpler and more controllable test objects than human tumor patients must be used if a suitable answer is to be obtained.

Further, the fact that the wave length problem has been discussed repeatedly at radiologic meetings is recognition of the importance of this problem. Three points may be mentioned upon which the problem has a bearing. The first and foremost, radiologically, is whether or not differential biologic effects can be obtained by properly selecting the quality of radiation to use; the second is whether or not the measurement of the different qualities of radiation from low voltage x-rays to gamma rays in a common unit will have any useful significance, and the third, of theoretic importance, whether or not ionization and biologic effect will, in last analysis, be found to go hand in hand. The last point will have an important bearing on any attitude which may be developed in regard to the mechanism of the action of radiation in causing biologic change.

Thus, because of the tremendous importance of the problem of wave length, even the slightest information is of interest and must be examined as to reliability and meaning.

Dr. Packard has carefully described his experiments with *Drosophila* eggs. He has at last been able to do the thing that

many have wanted but have been unable to do because of lack of facilities, namely, to obtain a wide range of wave lengths of radiation from the same x-ray machine for treatment purposes, thus eliminating many of the uncertainties arising from varied conditions.

Dr. Packard has presented three curves, the last two of which bear out facts that have been well established, namely, that as the radiation increases in hardness, the back-scattered radiation becomes less, and the depth dose becomes more. Moreover, his findings with *Drosophila* eggs are not greatly unlike those obtained by other means. His first curve, however, presents something entirely new. It shows that whereas there is a close correspondence between the intensity of radiation detected by the *Drosophila* eggs and the Victoreen instrument for voltages up to 250 kv., a distinct and progressive difference develops between 250 kv. and 400 kv., the difference remaining nearly constant beyond 400 kv. Thus the findings clearly manifest evidence of wave length dependence.

Heretofore, Dr. Packard has been able to find an explanation of any wave length discrepancy which might occur between the Victoreen instrument and the eggs. In the present instance, however, no explanation has been offered. He does mention, nevertheless, that the difference was even greater before the addition of a sheet of celluloid both above and below the test material during treatment. This, he states, was for the purpose of "assuring that the intensity of secondary beta radiation everywhere within the material will be in equilibrium with the incident primary x-radiation." He gives the thickness of the celluloid used as 0.10 mm. and one cannot help but wonder, if more celluloid had been used, whether the difference might not have disappeared altogether.

Through the courtesy of persons at the Institute for Cancer Research, it has been the privilege of my colleague, Dr. Francis, and me to carry out experiments with this same equipment operated at 700 kv. and to compare the effects with those obtained with certain other equipment operated at 200 kv. Instead of using an ionization chamber and *Drosophila* eggs, however, we used two biologic test objects (*Triticum* and *Lycopersicum* seedlings).

We, too, found a differential effect of appreciable amount and also that this was reduced by the addition of celluloid. Actually, even the change produced by the celluloid may be taken to indicate differential responses on the part of the different organisms. It would seem, therefore, that evidence is thus accumulating to show the existence of wave length dependence among radiobiologic reactions. We gave careful consideration to the findings, however, and the conclusion which we presented in connection with our manuscript, submitted for publication some time ago, seems to apply here. That is, in view of the fact that layers of celluloid can make such a significant difference in the responses of two organisms, small differences in the structural arrangement of the organisms themselves may cause significant differences in the amount of radiation absorbed at a particular point in the organism, thus making it necessary to know two things precisely before it is possible to demonstrate really the presence or absence of a wave length dependence.

The first is that the location of the sensitive region must be accurately known (*i.e.*, the size and shape of the sensitive zone and the amount of tissue which is above and below it), and the second is the exact amount of ionization produced in the sensitive region. These are rigid requirements and it may be impossible to attain them, but it would seem at this juncture that such would be necessary if the wave length dependence question, in last analysis, is to be answered satisfactorily.

In conclusion, therefore, Dr. Packard's findings, although tremendously interesting, are only suggestive. All we know is that for different qualities of radiation the *Drosophila* eggs and ionization chamber do not go hand in hand. Which, if either, measured the ionization properly is not known, and we shall have to await further results.

DR. R. R. NEWELL (San Francisco, Calif.): It is easy to convince yourself that there is a difference in the action on patients between one machine and another. I am always suspicious of my conclusions though, because there are so many factors which are not the same for the two machines, even in the same pair of hands. Therapy is not always carried on in exactly the same way in two different treatment rooms. We assign one sort of patient to supervoltage and another sort to deep therapy. More than that, the different parts of the body do not respond to radiation in the same way.

The extremities suffer very much more in late results than the face does. Those of you who have attended Dr. Widmann's clinic have heard how he recommends giving 1,500 r Monday, and repeating it Wednesday, and giving it again on Friday, and yet I have seen ulcerations result from a single dose of 1,500 r to the sole of a foot in a somewhat arteriosclerotic man, and the ulcer did not heal until about a year and a half later.

I say I have no difficulty in seeing at least superficial differences between the two, yet I think I see more similarities than differences in the reactions of the patient to 400 kv. and 200 kv. It did seem to us at first as though the reactions on the head and neck were somewhat slower; perhaps they were a bit dryer, perhaps there was more time between the reactions in the mucous membrane and the reactions in the skin. And yet, we have had instances in which the same thing was observed with even quite soft radiation.

I remember a lip that we treated with soft x-ray (H.V.L. 1 mm. Al). The mucous membrane appeared with its reaction and desquamation quite promptly after somewhat more than a week of daily doses. We stopped when, according to instructions, we had reached a large enough dose, and yet the skin reaction was not apparent. Finally, at long last, the skin reaction appeared and all the skin peeled off with a thick crust and we finished with a clearly perceptible degree of atrophy. I cite this as a case in which the course of the reaction and the late result, to me, were extremely similar from H.V.L. 1 mm. Al to what we had seen in other cases with H.V.L. 5 mm. Cu.

Now in regard to its superiority in use, we are certainly succeeding in getting more radiation into the center of a large pelvis with H.V.L. 5 mm. Cu than we were able to get with 200 kv. I am sure we see reactions in the cervix to supervoltage which we never used to see with 200 kv.

DR. LAURISTON TAYLOR (Washington, D. C.): Of particular interest to me was the curve which Dr. Packard showed in which his biologic calculation of the Victoreen ionization chamber calibration showed a marked change at 200 kv., and then again flattened out at 400 kv., and in the course of his explanation of that calculation, a little doubt was cast upon the significance of the Victoreen ionization chamber readings.

I will not say what a Victoreen or any other kind of a thimble ionization chamber means when used in a phantom, but these measurements of Dr. Packard's were difficult to carry out and he used essentially free air conditions. Since our paper, to which he referred, was published, Mr. Singer has carried out some very careful measurements in our laboratory on the calibration of several thimble ionization chambers against our large pressure air ionization chamber, and he has found that the chamber which is most commonly used now is essentially independent of wave length over the range of 120 to at least 400 kv. within an accuracy of perhaps plus and minus 2 per cent.

That is a most gratifying thing to find and a little surprising to me, but not surprising to the manufacturer of the chamber. We have carried out the physical measurements involved in this calibration in the best way that we know how. We have a good deal of confidence now in free air measurement with a standard ionization chamber, and we feel that the International roentgen can be realized in free air measurement with a suitable pressure ionization chamber, and, therefore, we feel that our calibration of the thimble chamber under free air conditions is of significance.

That is our opinion regarding the thimble chambers. Dr. Packard, as a result of his measurements and calibration of the thimble chamber by biologic means, reached a different result. I feel that there are two very different opinions which will have to be reconciled sooner or later.

DR. L. H. GARLAND (San Francisco, Calif.): It is generally conceded that it is not a knife which cures an operable cancer; it is the skillful use of that knife by a properly trained surgeon which results in a cure of that cancer. Should the surgeon use a longer knife than that which his colleague uses, he could talk about it as a superknife; yet it is highly improbable that his chance of curing a given cancer would be much enhanced by the use of such a superknife. It seems to me that many discussions on the relative merits of 200 kv. and 800 kv. irradiation resemble in some respects hypothetical discussions concerning a two-inch knife and an eight-inch knife. If a given cancer is sufficiently small and sufficiently accessible, it may be cured by a competent surgeon or a competent radiologist irrespective of the length of the knife or the voltage of his machine. Most cancers are, unfortunately, neither small nor accessible when they first present themselves for treatment, and, therefore, no matter how super the supervoltage, the chance of cure is slender indeed.

As regards the physical reactions in the vault of the vagina following adequate dosage with external roentgen irradiation, it is my impression that the reactions seen in the vault following proper treatment with 200 kv. are virtually the same as in those patients treated by Dr. Newell with 350 kv. and by Dr. Stone with 900 kv. There is no doubt that physical measurements reveal some superiority in hard high voltage irradiation, but clinical measurements reveal so slender a superiority that its existence is still debatable.

Concerning Dr. Witwer's paper on irradiation reactions, I would like to say that it is an excellent demonstration of the harm which roentgen and radium irradiation can do. It is, of course, no argument at all as to the inferiority of low voltage. The late reactions which he showed took, on the average, nine years to develop and followed enormous dosage, carelessly or incorrectly given. There is not the least doubt that similar reactions would follow enormous dosage with supervoltage irradiation, carelessly and incorrectly given. Some of you have seen late radium reactions of an unfortunate nature; few of you will deny that well filtered radium irradiation is supposedly equivalent to about 2,000 kv.

DR. CHARLES B. WARD (Seattle, Wash.): I wish to call your attention to the fact that Dr. Newell, a very good physicist, has been checking his depth dosage measurements by examining the vaginal vault. At previous meetings I have suggested this as the most accurate way of estimating the depth dose. If there is a malignant lesion in the vault of the vagina in a thin woman, you can note a very definite reaction in the mucous membrane when the patient is treated with the 200 kv. machine. If a higher voltage is used, there is a marked increase in the reaction, and this difference is greater than one would expect from comparing depth dose measurements.

I am sure that we will get the most accurate estimate of depth dose measurements by watching the vault of the vagina at frequent intervals during the treatment, and, if this is carefully done, it will be found that the higher voltage gives a definite increase in dosage.

DR. KENNETH ALLEN (Denver, Colo.): I would like to refer to Dr. Leucutia and Dr. Witwer's paper again. I wonder if the effect of x-ray on skin, which he showed as causing malignancy, could not be due to the manner in which low voltage was used instead of the fact that it was low voltage. In Colorado, the patients who come to us from that and surrounding States show a high percentage of epithelioma of the skin and lips, and we treat a great number of them. Perhaps the bright sun is an etiologic factor. For years we have been giving such patients 5,000 or 6,000 r in one dose, and we do not treat just the epithelioma itself, but the surrounding normal skin. Not one do I remember as coming back with a radiation malignancy.

We follow all patients for at least five years—some longer—and scores of them have returned for observation, and not one has ever shown in this highly treated area of normal skin any post-radiation cancer.

In our cases, a small portal was used, but Dr. Widmann has shown case after case which has been treated with 4,500 r in a week, and in which the field was at least 10 × 10 cm. So it is not the size of the port. I wonder if, instead of being intrinsically low kilovoltage that caused Dr. Witwer's cases of skin cancer, it might not be the result of repeated treatment over a period of years. I think most of his cases were treated year after year.

DR. G. C. LAURENCE (Ottawa, Canada): I should like to refer briefly to some of the theoretical aspects of this problem.

One of the simplest theoretical approaches is, of course, to base our theory on the assumption that, other things being equal, the significant factor is the amount of energy absorbed in the tissue. Now there is a very widespread impression that the physicist would expect from such considerations much greater skin tolerance at 1,000 kv. than at 200 kv.—about 100 per cent greater or more. Perhaps a little further explanation here is desirable. It is not entirely true.

The impression seems to be based on a paper published by Dr. Lauritsen[1] some years ago, which contains a curve showing the variation of the minimum erythemal dose with the voltage applied to the x-ray tube, as expected from energy considerations. Dr. Corrigan reproduced this curve in one of his slides. You may remember that the curve rises steeply at the high potential end. It is a difficult curve to derive from the mathematical standpoint. Dr. Lauritsen was chiefly concerned at that time with calling our attention to certain general considerations, and, very sensibly, he made a number of approximations that would make the mathematics much simpler.

For our purpose in this discussion, we require better accuracy than Dr. Lauritsen's approximations permit. Recent experimental data on back-scattering show his curve rises much too rapidly at the high potential end. The curve should, of course, depend on the conditions of treatment. Particularly important are the area of the port and the focus–skin distance. I have calculated such curves by somewhat different methods assuming conditions that are typical in the clinic, and obtained curves that are quite different from his. They are much flatter. Instead of that 100 per cent increase, we get a variation between 200 kv. and 1,000 kv. that is of the order of 5 to 25 per cent, depending on conditions.

Dr. Lauritsen's important paper has justly received wide attention. For this reason I thought it worth while to point out that his curve was not intended to be very accurate, and that, in fact, it shows too great a difference between the effects of 200 kv. and 1,000 kv.

In making comparisons between theory and clinical experience, perhaps the disagreements that are reported are due to the difficulties in interpreting the clinical experiences. Port area, filtration, focus–skin distance, and other physical conditions must be taken into account. Actually I think we should reserve judgment on this question, whether or not theory agrees with clinical experience, until our methods of measuring the dose of supervoltage x-rays are established. One feels dissatisfied with the use that has been made of thimble chambers, calibrated with 200 kv. rays, for the measurement of 1,000 kv. rays.

These curves, the ones I mentioned, are based on *free air* measurements of the dose. If the theory is based on measurements of the dose *at the skin surface* (including back-scatter), the theory predicts that there is practically no difference in the reaction at 200

[1] Charles C. Lauritsen: Energy Considerations in Medium and High Voltage Therapy. Am. Jour. Roentgenol. and Rad. Ther., **30**, 529–532, October, 1933.

Idem: Energy Considerations in High Voltage Therapy. Am. Jour. Roentgenol. and Rad. Ther., **30**, 380–387, September, 1933.

kv. and 1,000 kv. This is shown in a curve published by Mayneord[2] about a year ago.

DR. KENNETH E. CORRIGAN (*closing*): There seem to be only two definite points for me to discuss in closing. One is the matter of chamber calibration, brought up by Dr. Taylor. To what he said I can add that in our own case the open air chamber is located in a room below the end of the tube at a distance of about two meters, and is so arranged that the beam, after passing through the chamber, goes through a hole in the floor of the room into a well and is fairly well disposed of. We think the chamber is reasonably accurate. We have been able to check the ordinary thimble chamber against that up to about 550 kv. with no significant divergence.

DR. HENRY SCHMITZ (*closing*): Without going into a discussion of the papers that were read before mine, I wish to make a few statements. First, supervoltage should be used only in deep or massive tumors. In our work at Chicago, we use the 200 kv. machine and sometimes the 140-volt, probably as frequently as we use the supervoltage machine. In other words, for carcinoma of the mouth and the oral cavity and larynx, we invariably rely on the 200 kv. x-ray, because we find that it is entirely unnecessary on account of the transverse diameters and the nearness of the tubes to the surface to use ultra-high voltage.

At present we must rely on empirical evidence, and by that I mean on the evidence as we see it in supervising and treating our patients. The final proof is yet to be made, by the biologist, the physicist, or the clinician. It is evident that if we can prove there is a higher survival rate in the supervoltage method of radiation than in any other, then the supervoltage x-ray is the radiation of choice in deep and large tumors.

The number of cases reported is too small to consider the final efficacy. Take, for instance, the 17 five-year entries that I presented with nine five-year survivals. Let us assume that in the four-year cases, two, three, or four should die during the fifth year, then the five-year survival rate would immediately drop to 40 or 35 per cent. We should wait until we have a large number of five-year survivals—probably a hundred cases—to determine the necessity of the use of ultra-high voltages.

Those using 200 kv. should not worry, since that method is useful and necessary.

DR. LAURISTON TAYLOR (*adding*): I am afraid I used the wrong wording in discussing Dr. Packard's paper. The point I meant to bring out was that I think we now have reason to gain confidence in the significance of the thimble chamber as used for the measurement of the International roentgen. We likewise have every reason to have confidence in Dr. Packard's work. I feel, however, that sooner or later we will have to know why the difference exists between the two types of measurement. There is no reflection on Dr. Packard's work.

DR. CHARLES PACKARD (*closing*): The reason for the difference between the biologic and Victoreen readings at the higher voltages is not yet apparent. The two methods of measurement agree at low and at moderate voltages. In view of Dr. Taylor's statement that this thimble chamber appears to read correctly at about 400 kv., one would expect the biologic results to agree with it at this point. The lack of agreement here and at still higher voltages is an important question which must be solved in the future.

In regard to the use of celluloid as a cover for the test material, I need only repeat that it is employed in order that the intensity of secondary beta radiation may be in equilibrium with the primary beam. The thickness required was determined by the use of a small thimble chamber the walls of which were made of goldbeater's skin. When a single sheet of celluloid is interposed between the target and the chamber, the intensity of radiation is found to increase. Additional sheets bring about a still further increase, until the total thickness is about 0.8 mm. No further increase is noted when more celluloid is added. In other words, equilibrium has been attained.

[2] W. V. Mayneord: The Significance of the Roentgen. Unio Internationalis contra Cancrum Acta, 2, 271–282, 1937.

ROENTGEN-RAY TREATMENT OF HYPERTHYROIDISM[1]

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HYPERTHYROIDISM is a condition which concerns especially the general practitioner, the endocrinologist, the ophthalmologist, the surgeon, the radiologist, and, in fact, enters at times, as a complicating factor, into almost every other branch of medicine. It is quite proper, therefore, that this subject should be studied in its various phases in this Post-graduate Institute. My interest in the treatment of hyperthyroidism dates from 1904, or about thirty-five years. I am pleased, therefore, that I should be called upon to discuss the irradiation treatment of hyperthyroidism.

Thousands of cases of hyperthyroidism have now been treated and recorded by various authors (Borak, Ginsburg, S., Groover, Christie and Merritt, Harris, Holzknecht, Loucks, Menville, and others). I have myself written on this subject on six previous occasions. The results in general have shown about 65 per cent cures, about 20 to 25 per cent marked improvement, and about 10 per cent failures. This is also approximately the records obtained by surgery. In other words, about 90 per cent have been restored to working ability. The general practitioner is usually the first to come in contact with a case of hyperthyroidism. To him belongs the responsibility of making the diagnosis, and its differentiation from other similar clinical syndromes, and he should remain in charge until the patients are restored to a normal condition and until they are able to carry on their occupation. Treatment does not consist merely in treating the thyroid, either by irradiation or operation, but the predisposing and exciting causes should be removed, and after active local treatment the patient should be guided and guarded by competent medical advice such as the general practitioner can give. Crile says:

> "In 3.3 per cent of our total cases, there is a recurrence of the hyperthyroidism after partial thyroidectomy. In every case in which this occurs, it will be found that there has been a persistence of the agents which were active in producing the primary hyperthyroidism—focal infection, social maladjustments, worry, overwork or some other strain."

It is well known to you all that patients who are suffering from hyperthyroidism associated with a goiter postpone the consultation with their family physician for fear he or she will be sent to a surgeon for operation. To avoid such delays and to conserve the patient's energy, it is, therefore, well to remember that irradiation therapy is approximately of equal value with surgery in the end-result, and if patients learn that not all cases must be operated upon, they will be less likely to delay consultation.

In dealing with hyperthyroidism, we must assume that there is an overgrowth or a new-growth of the thyroid gland, or a hyperfunction of the normal amount of glandular tissue. The condition can be relieved by surgery and satisfactory results can be obtained if the surgeon removes just the right amount of tissue; or the disease can be controlled by irradiation which gradually reduces the activity of the cells, and causes an atrophy of the hypertrophic or hyperplastic tissue when present. This reduction in the activity of these cells takes place even when no enlargement or tumor is present. By careful observation and basal metabolic rate control, one need not exceed the necessary dosage to bring the condition to normal. It is my practice to discontinue the treatment when the basal metabolic rate has reached approximately 15 per cent. It will probably gradually descend to normal.

[1] Prepared for a lecture in the Post-graduate Institute of the Philadelphia County Medical Society, March 13–17, 1939.

Indications for Irradiation.—Based upon personal observations and those of other radiologists, I believe that irradiation is indicated in all cases of hyperthyroidism in which the patient is not in crisis, or is not suffering from definite pressure symptoms. On the other hand, operation should be recommended in all simple or non-toxic goiters unless there is some contra-indication, in which case a moderate amount of irradiation may be used. Sometimes brilliant results are obtained, even when large goiters of this type are present. Hyperthyroidism is often overlooked or the diagnosis is delayed in patients past fifty(Bram). Bram mentions especially in this group of cases, tachycardia, palpitation, dyspnea, auricular fibrillation, asthenia or fatigability, and a coarse tremor, associated with arterial hypertension, as the most prominent symptoms.

ADVANTAGES OF IRRADIATION

1. The fear of operation is eliminated and, therefore, the patient is more likely to come under treatment early and before cardiac damage has taken place.

2. If the patients are treated reasonably early, they are not interrupted in their occupation. When the disease is well advanced or serious symptoms are present, they must, however, be put at rest.

3. There is no pain or shock and no great inconvenience if the condition is treated reasonably early.

4. Patients with advanced disease or serious heart complications may be treated without shock, and, if radium is used, need not even be removed from their rooms or beds.

5. There is no risk of mortality from the treatment.

6. There is absence of scars or keloid formation.

7. The end-results are approximately equal to those obtained by surgery.

OBJECTIONS TO IRRADIATION TREATMENT

1. The *danger of burns* naturally comes into a patient's mind, because they occurred occasionally in the early years of irradiation therapy when the method was being developed, and when the dosage could not be accurately measured. Since such damaged patients do not die, a few such accidents in the country become known far and wide, whereas if a patient dies during an operation from any accident or any complication, burial takes place. The loss is accepted as one of the hazards of the procedure and may be ignored, or is soon forgotten.

2. *Telangiectasis and skin atrophy* are dangers which must be taken into consideration. In a former series of 533 cases reported by me, telangiectasis had occurred in 3 per cent of the cases, but all of these occurred in the earliest traced cases treated. There have been no such damaging effects in the recent series. Such damage depends upon the total amount of irradiation. While it may follow a single excessive dose of rays, it may occur without any erythema ever having been produced, providing there are many small doses given over a long period of time. I have not seen telangiectasis in any cases in which I had not given more than eight series such as is described in my technic. I aim, therefore, to obtain results with from five to eight series. Even when present, with the exception of one case, it has been only slight, and has not bothered the patients very much.

3. *Exacerbation of symptoms* may occur after the first treatment. This has rarely occurred in any of my cases. Such exacerbation has been especially emphasized by Borak, Pordes, and Goette. In my experience such an increase has been insignificant and no more than may occur from time to time independent of treatment. It must be borne in mind that patients will sometimes develop an increase in symptoms because of the new form of treatment having been undertaken. If such an increase is feared, it may be well to decrease the dose in the first series, especially in the severe cases.

4. *Myxedema* has not occurred in any of my cases. Hypothyroidism occurred in four of the former series of cases reported, and in none in the present series. In only

one of these four cases was it sufficiently severe to require the use of desiccated thyroid. Groover reported subsequent hypothyroidism in only 1.3 per cent of his cases. My low percentage of hypothyroidism after irradiation is in part due to the ability to reduce the excessive secretion gradually, and in part to the fact that the normal thyroid cells are resistant to irradiation. Normal thyroid tissue and normal parathyroid tissue are resistant to irradiation and will not be affected by the amount of irradiation needed to control hyperthyroidism. This has been proven not only by clinical observation but by the experimental work of Walters, Anson and Ivy, and by Bower and Clark. Clinical proof of the absence of danger of damaging the thyroid cells or the parathyroids in the treatment of hyperthyroidism is shown by the fact that with the enormous amount of irradiation given in the treatment of cancer of the larynx, I have not observed any case of hypothyroidism or tetany, and I know of no such record in the medical literature. The fear of this, therefore, need not constitute objection to the treatment.

5. *Difficulty in subsequent surgical treatment*, if this should be necessary, has been adduced as an objection to irradiation. This objection need only be considered in a small percentage of cases (in only 7 per cent of my own cases was subsequent operation necessary, and in only one of these, an early case in the series, was any difficulty involved). It is now generally admitted that adhesions are found in as many cases which have not had previous irradiation as in cases which have been treated. Eiselberg, who was first to consider adhesions as a post-irradiation complication, now regards them as irrelevant.

6. *Slowness of response to irradiation* has been objected to, but with irradiation one usually gets some improvement at the end of a month and very definite improvement at the end of two months. If the surgeon uses two weeks for preparing his patient for operation, two weeks for recovery from the operation, and a month for convalescence, the time is two months; therefore, the difference in time is not so very great. At the end of these two months, however, one may generally expect a more complete relief of symptoms from surgery than from irradiation, because the surgeon removes the excess of glandular tissue at once, while with irradiation one reduces the hyperactivity and the hypertrophy or hyperplasia gradually. This is a slow and progressive effect. This slow response is not without its advantages, however, since the activity of the gland can be checked by frequent metabolic determinations and the final result controlled with greater nicety than when the hyperfunctioning gland is removed at one sitting. Therefore, if the patient is treated reasonably early, this slow recovery is not a serious objection. During this period of early treatment the internist should use all his known methods of helping the patient (such methods to be discussed later).

7. The question of *permanent cardiac impairment* developing during the prolonged irradiation treatment must be considered, since the improvement from irradiation comes more slowly than from surgery, but this difference is not so great as would at first appear. Because of the fear of operation which leads to delay, and, therefore, damage to the heart, it is likely that if irradiation is considered the patient will be treated earlier, before serious damage to the heart has taken place. This advantage will make up for any delay in the result from irradiation. Progress in cardiac impairment may also occur in cases treated surgically, as is indicated by the report made by Willius, in which he states:

"At the time of initial examination at the Mayo Clinic, auricular fibrillation was found in 7 per cent of patients with exophthalmic goiter, and in 9 per cent of patients with hyperfunctioning adenoma. These percentages are doubled while the patient is under observation, that is, during the pre-operative, operative, and post-operative periods. Auricular fibrillation may occur as a permanent, intermittent, or paroxysmal disorder."

Holzknecht has stated that,

"Not one case is found in the literature proving that the prolonged period of irradiation resulted in unnecessary damage to the heart."

8. *The danger of the development of carcinoma in toxic adenomas* has been advanced as a special argument in favor of operation in all toxic adenomas. No one can dispute that a considerable number of adenomas have been found to contain malignant tissue when removed and examined microscopically, but these early carcinomas are found in the non-toxic adenomas. Ewing says, "True tumors rarely develop in the Graves' thyroid." Cutler and Buschke state, "The hyperfunctioning thyroid rarely becomes the seat of cancer." In only one case out of a total of 501 cases of hyperthyroidism did carcinoma develop. This occurred in a female patient aged 64. Her physician had recognized an adenoma in the middle lobe of the thyroid during three years. It was about three centimeters in diameter and two centimeters in thickness. The pulse was irregular and at rest was 88; after exercise it was 96. The basal metabolism test on two occasions was plus 20 and plus 15. This was not clearly a hyperthyroid case and I suggested operation, but both the patient and the attending physician wanted to avoid operation if possible. Therefore, we gave seven series of x-ray treatments between May 6, 1933, and April 10, 1934. Two basal metabolism tests done on May 8, 1934, showed plus 1 per cent and plus 6 per cent. The patient was symptom-free and seemed to be well. There was still present at that time an adenoma, approximately half its former size. About Oct. 1, 1935, the patient developed a sense of soreness in the neck, the pain extending up into the head, but Dr. Francis Packard, who referred the patient to me, could find little wrong, yet he was unable to see below the cord. The patient thought she was suffering from a cold. I examined her on Oct. 21, 1935, at which time the patient was complaining of a sense of compression and of soreness upon swallowing. X-ray examination was made in a similar manner to that originally made on May 5, 1933. At that time (Oct. 21, 1935) I found that the anteroposterior diameter of the trachea was 15 mm., while at the examination on May 5, 1933, it was 11 mm. There did not, therefore, seem to be an increase in the compression. The heart shadow had decreased 1 cm. as compared with the examination on May 5, 1933. On Dec. 3, 1935, Dr. George Muller operated upon her and found a blood clot. He also removed a specimen for microscopic examination but did not think that it was malignant. On Dec. 13, 1935, Dr. Stanley Reimann reported carcinoma of the large cell type. Dr. Muller did a tracheotomy, but a few days later the patient died. No one can tell, therefore, whether or not this patient would have lived longer if she had been operated upon, as I suggested when she first came to me, than she did by receiving irradiation treatment, which gave her freedom from symptoms for about two years' time. Had the diagnosis of carcinoma been made at the beginning she would, of course, have received more x-ray treatment.

There have surely been 5,000 cases of goiter treated by irradiation and I cannot believe that if any considerable number had developed carcinoma, the fact would have remained unreported. Therefore, it would seem that irradiation prevents the development of carcinoma, or, if carcinoma is present at the beginning of the treatment, the x-ray evidently stops the growth of the carcinoma. Furthermore, it is recognized by everyone that for some reason carcinoma of the thyroid is unusually sensitive to irradiation. For example, many years ago the late Dr. John B. Deaver sent a woman to me from whom he had removed partially a carcinoma of the thyroid. In referring her to me, he told me definitely that he did not succeed in getting all of the carcinoma out. I treated her, and there was never any recurrence or development of this thyroid carcinoma during thirteen years. However, at the end of thirteen years she developed lung symptoms and we found extensive metastatic carcinoma scattered through the lungs. However, there was even then no evidence of any local car-

cinoma about the thyroid or around the neck, or in any of the areas which had received treatment, even though it was known to be present when I began treatment. This proves that I did control the carcinoma completely within the areas where the radiation was applied. Other cases in my experience and those of other radiologists have also given convincing proof of the radiosensitivity of carcinoma of the thyroid. Therefore, I believe that we need not let this fear influence us in the selection of treatment.

The nomenclature frequently used by the internists and surgeons is "economic restitution" or "rehabilitation." In my series of cases, it can be seen that an 89 per cent "economic restitution" or "rehabilitation" was obtained.

Hyperthyroidism without Palpable Glandular Enlargement.—The diagnosis in this group of cases is much more difficult, and it is quite natural that a much larger percentage of such cases should come to the radiologist than to the surgeon. In my group there were 59 of these cases: economic restitution occurred in 48; the treatment failed in 7, and 4 patients could not be traced.

Technic.—I routinely employ roentgen rays, using 130 kv., 5 ma., and 30 cm. distance, with the equivalent of 6 mm. aluminum filtration. The cervical region is divided into four fields, approximately 5 by 10 cm., the outline of the field being that of a truncated cone. Two of these fields are anterior, and two posterolateral. The anterior field, a truncated cone in shape, is arranged so that the inner border is near the median line. I usually try to allow a centimeter between the two anterior fields centrally, and the upper limit comes just to the upper border of the thyroid, which usually protects the arytenoids and the cords. The lower border extends below the clavicle and includes the thymic area. The larynx is protected with

TABLE I[2]

Classification of Cases	1905–1933	1933–1937	1905–1937
Hyperthyroidism			
treated with x-rays	440[a]	72[b]	512
treated with radium only	6	0	6
Non-toxic goiter treated with x-rays	59	11	70
Carcinoma of thyroid	28	0	28
	533	83[c]	616
Cases not treated	165[d]	39[e]	204
	698	122	820

a, including 40 cases treated at Women's Medical College Hospital.
b, including one case in which x-ray treatment was supplemented by radium therapy.
c, including 11 cases in which treatment was abandoned by patient before completion and three cases in which x-ray therapy was supplemented by operation.
d, non-toxic goiter.
e, including 10 cases of hyperthyroidism and 29 cases of non-toxic goiter.

1933–1937	*X-ray Treatment* Complete Series	X-ray plus Subsequent Operation	Treatment Incomplete	Total Treated	Not Treated	Total
1. Hyperthyroidism						
(*a*) Exophthalmic	31	0	1	32	1	33
(*b*) Goiter without exophthalmos	10	2	4	16	5	21
(*c*) No goiter or exophthalmos	11*	0	5	16	3	19
	52	2	10	64	9	73
(*d*) Recurrent after operation	6	1	1	8	1	9
Total hyperthyroidism	58	3	11	72	10	82
	61					
2. Non-toxic goiter	9	2	0	11	29	40
	67	5	11	83	39	122

* In 1905–1933, there were 48 cases.

[2] These statistics have been prepared from a review of my cases by my associate, D. A. Sampson, M.D.

lead. The rays are directed medially and downward so that a cross-firing effect is obtained in the thyroid and thymus region. The two posterior fields meet the anterior field to within about a centimeter, and the rays are directed downward and inward through the region of the cervical sympathetic ganglia toward the thyroid and thymus. An erythema dose (210–280 r) of from 30 to 40 per cent is given through each of these four portals, and usually this is given on one day so as to save the patient the trouble of coming for treatment repeatedly. Under certain circumstances, it may be advisable to divide these treatments over four different days or over two days. The series is repeated in three weeks, then in four weeks, and after that the interval is increased according to the improvements obtained. These several small doses will often be sufficient to show a definite decrease in the size of the goiter. In adenomas, localized doses are usually employed with cross-firing of the adenoma through two portals.

In the severer cases, it is better to begin with smaller doses and perhaps repeat in a shorter time. This dosage may be increased subsequently and the interval also increased. More than six series are rarely necessary, and I usually count on giving the patient from five to eight such series. I am reluctant to give more than eight such series. If a patient is not definitely improved after from three to five series and a lapse of two or three months from beginning of treatment, other measures should be employed.

Treatment of Hyperthyroidism by Roentgen Irradiation of the Pituitary Gland (Borak).—Pollitzer, Holzknecht, and Borak believe that there exists hypophyseal Basedow's disease. Jüggenberg had the impression that x-ray treatment of the thyroid in aged women with Basedow's disease gave poorer results than in younger women. She reported the detailed histories of seven women in whom the typical symptoms of Basedow's disease had come on after the climacteric, treated in vain with medical means and by irradiation of the thyroid, who were markedly benefited by irradiation of the pituitary. Borak reported ten similar cases in his own experience treated between 1925 and 1929. He refers to the biological foundation for the

TABLE II.—RESULTS OF X-RAY TREATMENT—1933–1937[3]

	No. of Cases	Cured	Markedly Improved	Not Improved
1. Hyperthyroidism				
(*a*) Exophthalmic	31	18 = 58%	13 = 42%	0
(*b*) Goiter without exophthalmos	12	7 = 58%	2 = 17%	3[a] = 25%
(*c*) No goiter or exophthalmos	11	9 = 82%	2 = 18%	0
(*d*) Recurrent after operation	7	4[b] = 57%	3[c] = 43%	0
	61	38 = 62%	20 = 33%	3 = 5%
2. Non-toxic goiter	11	6 = 56%	3[d] = 27%	2[e] = 18%
	72	44	23	5

a, Two cases subsequently had operation.
b, One case of non-toxic goiter included—operation 24 years previously.
c, One case subsequently had operation.
d, One case subsequently had operation.
e, One case subsequently had operation.

	No. of Cases	Cured	Markedly Improved	Not Improved
1905–1933	440	252 = 57%	135 = 31%	53 = 12%
1933–1937	61	38 = 62%	20 = 33%	3 = 5%
Total 1905–1937	501	290 = 58%	155 = 31%	56 = 11%
Total (cured or markedly improved)		445 = 89%		

[3] These statistics have been prepared from a review of my cases by my associate, D. A. Sampson, M.D.

treatment of the pituitary in experiments of Loeb in America, and Aron in France, working independently of each other. They produced typical Basedow's disease by the injection of hypophyseal extracts, and the intensity of these symptoms varied with intensity or the number of the injections. The injection of milk or tissue extract did not produce these results.

Borak says:

"In the course of the past twenty-five years, we have become completely convinced of the absolute safety of irradiating the pituitary because the brain surrounding the gland has been demonstrated, both clinically and experimentally, to be tissue especially capable of tolerating with impunity even the strongest doses likely to be used in therapeutic procedures."

Borak has treated the pituitary in 36 cases of hyperthyroidism. Of the 36 cases, 77 per cent showed favorable results. Of 16 cases treated primarily by irradiation of the pituitary, good results were obtained in 10 (62.5 per cent). Of these 10 cases, nine were women in whom hyperthyroidism came on after the onset of the menopause. He recommends treatment of the pituitary in all those women past the menopause, and treatment of the thyroid in those preceding the menopause. He states:

"Improvement grows in both types of treatment from the general to the particular, from the subjective symptoms to the objective symptoms. The nervous symptoms, the irritability, the fatigability, sleeplessness, headache improve first. Then the body weight begins to increase and the basal metabolic rate to decrease. Then there begins an improvement in the classic triad, so that the face of the thyroidism is the last to clear up. The tachycardia, the goiter, and the exophthalmos disappear slowly and in some cases there is complete return to normal."

Technic of Pituitary Treatment.—Borak further says:

"We treat the thyroid through an anterior and two lateral fields at two-day intervals. In the same way the pituitary is treated through a frontal and two temporal fields. The dose on the skin at each treatment, as it is in the case of the thyroid, is 200 r. Because of the fact that the thyroid is quite superficial and the pituitary is located at a depth of 7 cm. on the average, and so the effective dose is only about 40 per cent of that effective in the skin, the three fields are treated for a second time after eight days. The other treatment factors are 0.5 mm. zinc filter, 30 cm. distance, 170 kilovolts.

"If the basal metabolic rate or the pulse deviate greatly from normal at the end of eight weeks, we repeat the radiation series. We have given a third series only in case of recurrence.

"Aside from headache, which occurs now and then on the day of treatment, we have never seen any upset from irradiation of the pituitary. This agrees perfectly with what has happened in the thousands of pituitary treatments which I have given for various reasons to hundreds of patients during the last ten years. This roentgenologic technic is perfectly safe and without any danger whatever."

Iodine and Roentgen Therapy in Hyperthyroidism.—I am convinced that it is inadvisable to use iodine in conjunction with roentgen therapy. As has been shown in the previous discussion, the roentgen rays have an excellent effect on the thyroid cells when they are in an excited stage, but the rays have very little effect on the thyroid when the cells are not stimulated or in an excited condition. Therefore, if we quiet this hyperactivity temporarily by the iodine, we fail to get the satisfactory effects from the irradiation which are more permanent and the iodine loses its effect. It is well known that iodine does give good results in exophthalmic goiter, also in about half of the toxic adenomas, but these effects are lost after a time, and it is not considered good technic to continue over long periods. I prefer to treat a patient who has not even had iodine treatment: it seems to me that I get definitely better results. The Mayos stated:

"At the Mayo Clinic, iodine is not administered except for special purposes to a patient who had adenomatous goiter *without* hyperthyroidism. However, since 1923, it has been freely but not routinely administered to patients who had adenomatous goiter *with* hyperthyroidism and no harm had been seen with such use *within the week or two before operation* had been performed."

With regard to the effects of iodine in adenomatous goiter, I cannot do better

than to quote from Jackson and Freeman, who write in their summary:

"1. There may be produced iodine-fast cases of exophthalmic goiter.

"2. Iodine not only does no good but is definitely contra-indicated in non-toxic adenomas of the thyroid.

"3. There is danger in administering iodine in cases of adenomatous goiter, of producing 'iodine hyperthyroidism.'

"4. Adenomatous goiter does not become toxic before the patient has reached the age of 30 unless the toxicity is brought on by the injudicious use of iodine.

"5. We have shown that iodine may and does produce thyrotoxicosis in adenomatous goiter, as opposed to the contention of Means and Lerman.

"6. The effect of aqueous solution of iodine in toxic adenoma is not constant or specific and is not the same as that produced in exophthalmic goiter.

"7. Approximately 62 per cent of all cases of toxic adenoma are benefited by iodine or are not affected, while 38 per cent are made worse.

"8. In a series of cases of toxic adenomas, toxic symptoms and the basal metabolic rate were aggravated by aqueous solution of iodine.

"9. Owing to its variability of action, we believe that iodine should be given as a routine in all cases of toxic adenoma *before and after operation*, because two-thirds of the cases will be improved, and the harmful effects on the third is negligible over a *short* time."

It will be seen that iodine cannot be given indiscriminately to patients suffering from toxic adenoma. In a few cases in which the attending physician believed that the iodine was absolutely necessary, I requested that the iodine be discontinued for a period lasting from a few days to a week before the irradiation was to be given. It probably will not interfere if given after the treatment or between treatments, though I prefer to work independently; then I can judge my results.

General Care and Observations.—A careful record of the patient's pulse, weight, general health, and the condition of the skin is made at each visit, and frequent metabolic determinations are made. Foci of infection are removed. Chest examinations are made routinely at the beginning on each patient. I recommend administration of quinine hydrobromide five grains three times a day, unless ringing in the ears occurs (Bram). Dodd's lotion is prescribed for application to the neck to avoid skin damage. The patient is cautioned against sunburning the neck or applying irritating salves or lotions. Rest, so far as practicable, is advised, the patient being told never to stand when he can sit, and never to sit when he can lie down. A high caloric diet of easily digested food is recommended. Bread and butter, cereals, dairy products, practically all varieties of fruits and vegetables constitute the major dietary ingredients and should be taken in maximal amount. Until he or she regains weight, the average patient requires practically twice the amount of food taken during health. Tea, coffee, condiments, spices, and all alcoholic stimulants should be strictly forbidden. Tobacco should be stopped. Diet has been especially emphasized by Bram.

Means, Hertz, and Lerman have recently not only emphasized the importance of the uncontrolled factors in Graves' disease, but they call attention to the fact that *not only does hyperthyroidism cause a loss of weight but a loss of weight may cause hyperthyroidism, and make a report of 35 such cases* (14 of the 35 cases developed the hyperthyroidism following weight-reduction cures). Aub, Bauer, Heath, and Ropes have also called attention to the marked excretion of calcium and phosphorus in connection with thyroid disease and parathyroid disease. They call attention to the fact that in hyperthyroidism the calcium loss is great but the serum calcium is not increased. This loss of calcium not only depends upon the disease but also to a certain extent upon the intake of calcium. On that account I am giving these patients in addition an increased amount of calcium together with cod liver oil in some form. This seems to be logical and cer-

tainly can do no harm. These authors also call attention to the specific rôle in thyrotoxicosis that may be played by a shortage of vitamin B. It seems, therefore, important that not only should we give the patient a high caloric diet, but the patient should also have a high vitamin diet. For the high caloric intake the chief dependence should be placed upon carbohydrates. Excessive protein is undesirable because, through its specific dynamic action, protein raises metabolism. Carbohydrates, on the other hand, in large amounts is insurance against depletion of the glycogen stores of the liver and thus safeguard that organ.

SUMMARY AND CONCLUSIONS

1. Irradiation with either roentgen ray or radium may be accepted as a useful method of treatment of hyperthyroidism, since the end-results are approximately equal to those obtained by surgery.

2. The fear of operation or delays preceding operation are likely to lead to cardiac enlargement. This delay can be eliminated by the use of irradiation therapy.

3. Irradiation therapy does not involve shock or great inconvenience.

4. Associated medical care and general directions for conservation of energy are essential.

5. Irradiation is probably of value in the prevention of the development of carcinoma.

REFERENCES

1. Aub, J. C., Bauer, W., Heath, C., and Ropes, M.: Studies of Calcium and Phosphorus Metabolism: Effects of Thyroid Hormone and Thyroid Disease. Jour. Clin. Invest., **7,** 97–137, April, 1929.

2. Borak, Jonas: Die Rontgentherapie und die Organtherapie bei innersekretorischen Erkrankungen. Strahlentherapie, **20,** 263, 1925.

3. Idem: The Treatment of Hyperthyroidism by Roentgen Irradiation of the Pituitary Gland. Radiology, **24,** 535–549, May, 1935.

4. Bower, J. O., and Clark, J. H.: The Resistance of the Thyroid Gland to the Action of Radium Rays: The Results of Experimental Implantation of Radium Needles in the Thyroid of Dogs. Am. Jour. Roentgenol. and Rad. Ther., **10,** 632–643, August, 1923.

5. Bram, Israel: Exophthalmic Goiter in Patients Past Age 50: Comments Based on a Series of 322 Cases. Pennsylvania Med. Jour., **42,** 117–120, November, 1938.

6. Idem: Exophthalmic Goiter: Its Medical Treatment: End-results in 2600 Cases. Delaware State Med. Jour., **10,** 223–229, November, 1938.

7. Crile, G. W.: Clinical Analysis of 20,000 Operations on the Thyroid Gland, with Special Reference to the End-results. Proc. Internat. Assemb. Inter-State Post-grad. Med. Assn., North America (1929), **5,** 392–396, 1930.

8. Cutler, Max, Buschke, Franz, and Cantril, Simeon T.: Cancer: Its Diagnosis and Treatment, p. 605. W. B. Saunders Co., Philadelphia, 1938.

9. Ewing, James: Neoplastic Diseases, Third edition, p. 949. W. B. Saunders Co., Philadelphia, 1928.

10. Ginsburg, S.: The Value and Place of Radium in the Treatment of Diseases of the Thyroid Gland. Am. Jour. Roentgenol. and Rad. Ther., **24,** 283–297, September, 1930.

11. Goette, K.: Ueber Schädigung nach Bestrahlung von Morbus Basedowii. Fortschr. a. d. Geb. d. Röntgenstrahlen, **39,** 111–113, January, 1929.

12. Groover, T. A., Christie, A. C., and Merritt, E. A.: Treatment of Hyperthyroidism by All Methods, with a Summary of the Authors' Experience with Roentgen Therapy. Am. Jour. Roentgenol. and Rad. Ther., **10,** 385–393, May, 1923.

13. Groover, T. A., and others: Roentgen Irradiation in the Treatment of Hyperthyroidism: A Statistical Evaluation Based on 305 Cases. Jour. Am. Med. Assn., **92,** 1730–1734, May 25, 1929.

14. Harris, J. H.: Radiation Treatment of Hyperthyroidism: Report of Results at the Hospital of the University of Pennsylvania during the Seven and One-half Years Ending July 1, 1934. Am. Jour. Roentgenol. and Rad. Ther., **38,** 129–144, July, 1937.

15. Holzknecht, G.: Ueber die Röntgentherapie der Basedowschen Krankheit. Strahlentherapie, **30,** 605–612, 1928.

16. Jackson, A. S., and Freeman, H. E.: The Effect of Iodine in Adenomatous Goiter, with Special Reference to Toxic Adenomas. Jour. Am. Med. Assn., **106,** 1261–1263, April 11, 1936.

17. Loucks, R. E.: Clinical Evidence of Thyrotoxic Control after Radium Therapy. Am. Jour. Roentgenol. and Rad. Ther., **18,** 509–512, December, 1927.

18. Mayo, C. H., and Mayo, C. W.: Pre-iodine and Post-iodine Days: A Review of 37,288 Cases of Goiter at the Mayo Clinic. Western Jour. Surg., **43,** 477–482, September, 1935.

19. Means, J. H., and Lerman, J.: The Action of Iodine in Thyrotoxicosis, with Special Reference to Refractoriness. Jour. Am. Med. Assn., **104,** 969–972, March 23, 1935.

20. Means, J. H., Hertz, S., and Lerman, J.: Nutritional Factors in Graves' Disease. Ann. Int. Med., **11,** 429–436, September, 1937.

21. Menville, Leon J.: The Radiologic Aspect of Thyrotoxicosis. Radiology, **18,** 568–575, March, 1932.

22. Pfahler, G. E., and Thrush, M. C.: Exophthalmic Goiter Treated by Roentgen Rays. Ther. Gaz., **22,** 179, 1906.

23. Pfahler, G. E.: A Summary of the Results Obtained by the X-ray Treatment of Exophthalmic Goiter. New York Med. Jour., **88,** 781–783, 1908.

24. Pfahler, G. E., and Zulick, J. D.: The Treatment of Exophthalmic Goiter by Means of the Roentgen Ray. Am. Jour. Roentgenol., **3,** 63, 1916.

25. Pfahler, G. E.: New Roentgenographic Technic for the Study of the Thyroid. Am. Jour. Roentgenol., **8,** 81, 1921.

26. Idem: The Treatment of Hyperthyroidism by Roentgen Rays. Am. Jour. Electroth. and Radiol., June, 1924.

27. Pfahler, G. E., and Vastine, J. H.: Results of Roentgen Therapy in Goiter, Based upon Observa-

tions in 400 Cases. Am. Jour. Roentgenol. and Rad. Ther., **24,** 395–411, October, 1930.

28. PORDES, FRITZ: The Oligosymptomatic Thyrotoxicoses and Their Treatment by Roentgen Rays. Strahlentherapie, **30,** 619–633. 1928.

29. WALTERS, O. M., ANSON, B. J., and IVY, A. C.: The Effect of X-rays on the Thyroid and Parathyroid Glands. RADIOLOGY, **16,** 52–58, January, 1931.

30. WILLIUS, F. A.: The Heart in Thyroid Disease. Ann. Clin. Med., **1,** 269, January, 1923.

CHRONIC GASTRIC VOLVULUS[1]

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GASTRIC volvulus may be defined as an abnormal anterior or posterior rotation of part or almost all of the stomach about either the coronal or the sagittal axis of the body. The stomach, being fixed by the gastrophrenic ligaments above and by the peritoneum covering the second portion of the duodenum below, is limited in mobility between these fixed points only by the length of the lesser curvature and the length of the gastrohepatic omentum, and may be displaced within these limits by extrinsic pressure from whatever cause. Pressure displacement of the stomach is, therefore, very common, but actual rotation of a part or almost all of the stomach is relatively rare and would seem to require unusually long gastrohepatic and gastrocolic mesenteries to allow of its occurrence.

While the present discussion deals primarily with chronic or recurring volvulus, a brief consideration of the operative and postmortem findings in acute volvulus helps one to appreciate the anatomical arrangement and some of the probable causes of chronic volvulus.

This interesting condition is not of recent discovery, being first described by Berti (3), in 1886, who found the condition at autopsy. He described a forward and upward rotation of the entire stomach, with the exception of the subdiaphragmatic portion of the fundus, through an angle of 180°, so that the greater curvature lay uppermost against the diaphragm. In 1909, Payer (14) found 22 cases of acute gastric volvulus in the literature and added 12 cases, while in 1914, Kocher (10) was able to find 28 cases and added one case. In 1921, Deaver and Ashurst (7) stated that volvulus of the stomach had apparently been observed in 35 cases and that there were on record at least 22 cases in which operations had been performed for gastric volvulus. In 1930, Buchanan (5) presented an excellent review of the literature and added one case, while other cases of acute gastric volvulus have been reported by Thorek (18), Nockolds (13), Gill (8), Kerr (9), and others.

The earliest report of a case of chronic gastric volvulus is credited to Tuffier (19), who, in 1907, described the operative findings in a case of chronic partial gastric volvulus, the pyloric end only being involved. We are indebted to Rosselet (15) for the first report of a case of chronic gastric volvulus seen radiologically. In 1920, this observer reported a case of total organo-axial volvulus, seen fluoroscopically, in which the stomach was later found to be in normal position. The following year Rosselet and Gilbert (16) reported the first case of intermittent volvulus in which the finding was confirmed surgically. Since that time cases have been reported by Choisy and Babaiantz (6), Azmy and Marey (1), Myles (12), Shanks (17), and others.

From the operative and autopsy findings reported in acute cases and from the radiological findings in the chronic cases observed, the following classification or grouping is suggested.

1. Type.
   - (*a*) Organo-axial. Rotation of the stomach upward around the long axis of the stomach, *i.e.*, around the coronal plane.
   - (*b*) Mesentero-axial. Rotation of the stomach from right to left or left to right about the long

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

axis of the gastrohepatic omentum.

2. Extent.
   (*a*) Total. Cases in which the whole stomach, except the diaphragmatic attachment, rotates.
   (*b*) Partial. Instances in which the rotation is limited to a segment of stomach, usually the pyloric end.
3. Direction.
   (*a*) Anterior. Cases in which the rotating part passes forward.
   (*b*) Posterior.
4. Etiology.
   (*a*) Secondary to disease in the stomach or adjoining organs.
   (*b*) Idiopathic.
5. Severity.
   (*a*) Acute. Presenting a picture of an acute abdomen.
   (*b*) Chronic. Causing constant or recurring milder symptoms or symptomless.

Organo-axial volvulus, or rotation of the stomach about the coronal plane, is the more common form of total volvulus, the stomach rotating forward and upward so that the greater curvature lies uppermost between the anterior surface of the liver and the diaphragm, and the posterior wall of the stomach faces forward. The points on which the stomach rotates are the region of the esophageal opening of the stomach above, and either the pyloric sphincter or the second portion of the duodenum below. The degree of rotation is limited by the length of the gastrohepatic and gastrocolic omenta and the upward extent of travel is limited by the falciform ligament of the liver and by the liver itself. The amount of stomach taking part in the rotation varies. In the total variety, all but the fundic attachments and occasionally the pyloric end are involved, while in partial volvulus the pyloric end or the cardiac end only may rotate.

Mesentero-axial volvulus, or rotation about the long axis of the mesentery, is less frequent than the organo-axial type and is practically always partial, in that only a segment of the stomach rotates. The pyloric end is usually involved, though cases involving only the cardiac end have been reported (Morrison, 11). In rotation about the sagittal plane, the pyloric end of the stomach swings to the left, either anterior or posterior to the body of the stomach, more commonly the former, to lie to the left of the midline.

Etiology.—This rare condition is about equally divided between the sexes. There is no typical age incidence, though almost all reported cases have been in adults. In a number of cases of partial volvulus, the upper or lower sac of an hourglass stomach is involved. The sac of the stomach above or below the hourglass rotates laterally or upward, causing obstruction with or without strangulation of blood supply or perforation. Most cases of total organo-axial volvulus of the stomach are, however, not associated with any pathologic change in the stomach.

There is generally assumed, however, the presence of abnormality of the mesenteries as a cause of gastric volvulus and in operative and postmortem reports there is frequently noted an abnormally long gastrohepatic omentum and transverse mesocolon. In Kerr's (9) case there was a tear in the gastrohepatic omentum through which the rotating pyloric end of the stomach had passed, though the tear was probably the result of the volvulus rather than the cause. As a further evidence of long mesenteries is the frequent report of marked gastroptosis present after the volvulus has been reduced.

Diaphragmatic hernia is frequently cited as a cause of volvulus of the stomach. Payer (14) found 12 cases of gastric volvulus in 500 cases of diaphragmatic hernia, and Bowen (4) reports a case of volvulus in an inverted intrathoracic stomach. While it seems that diaphragmatic hernia has been frequently associated with volvulus of the stomach, its part in the

etiology of volvulus is not clear, as many cases of volvulus have been reported in which the diaphragm was intact.

"Arocolie," or distention of the colon with gas, has been advanced as the etiologic factor in gastric volvulus, by pressure from distended transverse colon or splenic flexure. While considerable displacement and pressure deformity of the stomach may be produced by distended bowel, it seems questionable whether a true rotation of the stomach of any considerable extent can be caused by colonic distention in the presence of normal mesenteries.

The condition of hepato-diaphragmatic interposition of the colon may, however, have a relationship to volvulus as seen in the cases to be presented. In this condition, so well described by Shanks (17), the transverse colon or splenic flexure rolls upward and forward, and, in the case of the splenic flexure to the right, anterior to the stomach to lie above it, anterior to the liver, and posterior to the anterior portion of the diaphragm. Its travel upward is limited by the falciform ligament of the liver. The greater curvature is then pulled up by the gastrocolic omentum, causing partial rotation of the stomach.

The clinical picture of acute total gastric volvulus is that of acute abdomen with three more or less characteristic findings, *viz.*, early vomiting followed by violent retching and inability to vomit, inability to obtain passage of the stomach tube, and rapid meteorism in the epigastrium. These findings indicate obstruction at the pylorus, then at the cardia, then gastric distention.

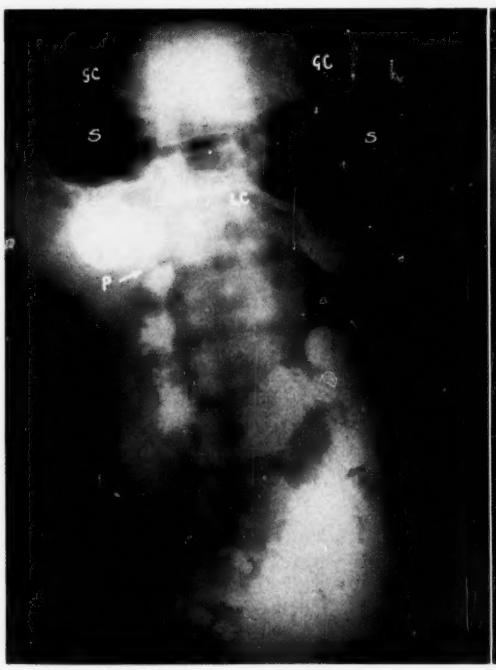

Fig. 1.

Fig. 2.

Fig. 1. Case 1. Mr. N. G., aged 48. Erect postero-anterior view shows total organo-axial volvulus of the stomach. Greater curvature (*GC*) is uppermost, lesser curvature (*LC*) is dependent. Large air bubble in stomach (*S*) outlines two fluid levels, one in the cardiac end and one in the pylorus. The pyloric sphincter is shown by an arrow at *P*. The duodenal caput points directly downward.

Fig. 2. Case 1. Mr. N. G., aged 48. Lateral view shows stomach in volvulus with the greater curvature (*GC*) uppermost. The body of the stomach is indicated by *S*. The transverse colon (*TC*) is abnormally high and lies anterior to the stomach in anterior hepato-diaphragmatic interposition. The position of the diaphragm is indicated by *D*.

Fig. 3. Case 1. Mr. N. G., aged 48. Antero-posterior view of the stomach and colon. Greater curvature is indicated by *GC*, lesser curvature by *LC*. *P* indicates the pyloric sphincter, *S* the cavity and fundus of the stomach. *T* indicates the transverse colon. Note that the transverse colon is in anterior hepato-diaphragmatic interposition and is situated higher than the stomach.

Strangulation of blood supply is frequently added to the obstruction, and perforation and death occur unless the volvulus is reduced in the following few hours. In cases of partial volvulus, the findings closely resemble those of high small bowel obstruction. In a number of the acute cases reported, there was a history of recurring attacks of similar type but less severe distress, suggesting that these patients had had previous attacks of volvulus which had undergone spontaneous resolution.

The relative rarity of the condition and the striking character of the radiologic findings seem to warrant reporting the three following cases.

Case 1. Mr. N. G., aged 48, was referred for gastro-intestinal series in November, 1934, with a history of epigastric distress and bloating immediately after meals for the previous year. Four and a half months before his radiologic examination, he had an attack of choking while sitting in a boat and was put to bed for two months by his family physician on a suspicion of having coronary disease. When seen by a cardiologist, however, he was found to have had no change in blood count, blood pressure, electrocardiogram, or temperature, and coronary disease was excluded. He was referred for radiologic examination because, on fluoroscopic examination, the cardiologist saw a double fluid level in the upper abdomen.

On fluoroscopic examination one was immediately struck by the presence of an apparently double-domed fluid level in the epigastrium, the domes being formed by the diaphragm. On administering the barium meal the fundus of the stomach was seen to be in normal position, as was the upper part of pars media, but the lower part of pars media, pars pylorica, and the duodenal caput had rotated forward and upward through 180° so that the greater curvature lay above the lesser curvature and was accurately applied to the inferior border of the diaphragm, anterior to the liver. The posterior wall of the stomach looked directly forward except at the extreme fundus. The pyloric end of the stomach and the duodenal caput pointed downward, forming a continuous curve with the second and third portions of the duodenum (Fig. 1). The double fluid level was explained by the high position of the lesser curvature in the region of the incisura angularis. In the lateral view the high stomach was seen to lie fairly well forward, anterior to the liver. The transverse colon was also very high and lay between the body of the stomach and the anterior portion of the diaphragm (Fig. 2). Colon examination by barium enema, followed by a second barium meal, proved the transverse colon to lie high in the abdomen, anterior to the liver and posterior to the anterior portion of the diaphragm. It also lay anterior to the stomach (Fig. 3). He has had no return of his symptoms in the past four years and we have been unable to get him back for further observation.

Case 2. Mrs. C. R., a robust woman 48 years of age, gave a history of recurring attacks of upper abdominal distress, lasting about one week, at intervals of from ten to twelve months for the past twenty years. During attacks, the upper abdomen became distended and tender. There was no periodicity or food relief to the distress. There has been no loss in weight. The reason for the radiologic examination was the hope of finding a lesion to explain a moderate degree of secondary anemia which was present.

On fluoroscopy, prior to giving the barium meal, a broad gas shadow was seen outlining the left dome of the diaphragm and extending well across midline to outline the mesial third of the right dome. On administering the barium, this shadow was seen to be due to air in the stomach. The fundus was large and situated on the left side. The pars media and pars pylorica were completely inverted, the lesser curvature being dependent and the greater curvature uppermost, the posterior wall looking forward and the pylorus and the duodenal caput pointing directly downward. Films made in the erect anteroposterior and lateral positions and recumbent and prone films showed that the stomach remained in this position. There was no pyloric or esophageal obstruction. There was no demonstrable lesion in the stomach or caput other than the inverted position (Fig. 4). The findings seemed to exclude simple cascade stomach, and, in order to exclude simple colonic displacement, colon examination by barium enema was done. This showed the colon to be of normal length and caliber. The transverse colon was of normal size, held high, and the distal half seemed to overlie the pars media of the stomach. There was no gas distention of the colon, the so-called "arocolie" of the French writers. There was no evidence of colonic disease (Fig. 5).

In order to demonstrate the permanence

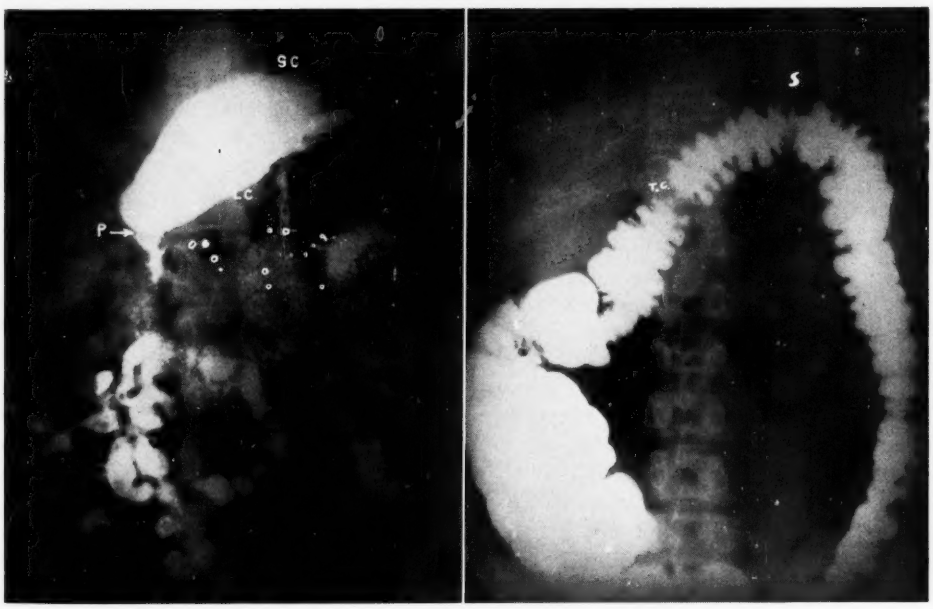

Fig. 4. Fig. 5.

Fig. 4. Case 2. Mrs. C. R., aged 48. Total organo-axial volvulus of the stomach. The greater curvature (*GC*) is uppermost, lesser curvature (*LC*) dependent. The pyloric sphincter is indicated by the arrow at *P*. The duodenal caput points directly downward.

Fig. 5. Case 2. Mrs. C. R., aged 48. Colon examination shows the transverse colon to be very high but otherwise normal. The transverse colon (*TC*) lies anterior to the fundus of the stomach (*S*).

Fig. 6. Case 2. Mrs. C. R., aged 48. Lateral view made after small barium meal following post-evacuation examination of the colon. Position of the diaphragm is indicated by *D*. Greater curvature (*GC*) of the stomach is above the lesser curvature (*LC*). Air bubble of the stomach is indicated by *S*. It can be noted that the transverse colon (*TC*) lies anterior to the stomach, so-called anterior hepato-diaphragmatic interposition.

of this gastric deformity, the patient was re-examined six months later with identical radiologic findings. At this time a barium enema was again done to exclude "arocolie" and a normal colon with high transverse was found. The patient was given a small barium meal immediately after making the post-evacuation colon film and no change in the position of the stomach was found. The transverse colon was again seen to be anterior to the pars media of the stomach, as shown in the lateral film (Fig. 6). In the interval, the patient's general condition and her anemia had improved under medical treatment. She felt well and was free of any abdominal distress.

Case 3. Miss F. R., aged 38, was referred for gastro-intestinal examination with the history of attacks of acute epigastric distress lasting from two hours to two days at intervals of a few months for the past fifteen or twenty years. She described her distress as a blown-up feeling in the upper part of her abdomen, for which the only relief was the belching of large quantities of gas. She had had three such attacks during the preceding year. Her acute attacks came on suddenly without any warning and abated as rapidly. Between attacks she was well, save for some constipation from which she stated she had always suffered. At the time her examination was undertaken she felt relatively well.

On fluoroscopy of the abdomen there was noted a broad gas shadow of about one and one-half inches uniform width and four inches in length immediately below the diaphragm in the midline. The shadow did not look like stomach and this impression was confirmed when the barium meal was given. The stomach was seen to be separate from the gas shadow which was situated anterior and to the right of the fundus. The stomach was large and low but presented no evidence of intrinsic disease. The subdiaphragmatic gas shadow was seen to be due to a loop of transverse colon which lay anterior to, above, and to the right, of the stomach in the location of hepato-diaphragmatic interposition (Fig. 7). This finding was proven at the six- and twenty-four-hour observations. When the patient came for the forty-eight-hour observation, she stated that one of her "attacks" had started that same morning, some four hours previously. Her face looked drawn and she complained of distress in the epigastrium and a sensation of being blown up which she attempted to relieve by repeatedly swallowing air and belching. On examination, the upper abdomen was slightly distended and some tenderness was present in the epigastrium. On fluoroscopy, the gas shadow in the epigastrium had definitely changed—was larger, lacked haustral markings, and presented the appearance of stomach (Fig. 8). On giving a barium meal this impression was confirmed. The stomach from the region of the esophageal opening to the second portion of the duodenum had rotated forward and upward through 180°

so that the greater curvature was uppermost between the liver and the diaphragm; the pylorus and the duodenal caput looked downward, and the posterior wall of the stomach looked directly forward. The colon was no longer in the position of hepato-diaphragmatic interposition but was in its normal location (Fig. 9). Twenty-four hours later the patient came in for barium enema. In the interval, her distress had passed off at eight o'clock the previous evening and she was feeling quite well. Colon examination now showed that the gastric volvulus had reduced itself, while the transverse colon had returned to the state of hepato-diaphragmatic interposition (Fig. 10).

In July, 1938, some four months later, the patient became acutely ill and was operated upon by J. C. R. Edwards, M.D., of Newmarket, who found a volvulus of a megasigmoid. I quote from Dr. Edwards' operative notes: "There was made out a volvulus of a tremendously enlarged sigmoid—all of the ileum being wedged into the pelvis below the sigmoid. The circulation of the bowel was not impaired. All the bowel which could be reached had a very long thick mesentery. One could lift any portion of the bowel clear of the abdomen for eight to ten inches. The stomach appeared to be in normal position."

DISCUSSION

The radiologic findings in chronic gastric volvulus are so characteristic that they are not likely to be confused with any other lesion. One usually obtains a clue from seeing the high transverse gas bubble under the dome of the diaphragm on both sides of the midline and the barium meal con-

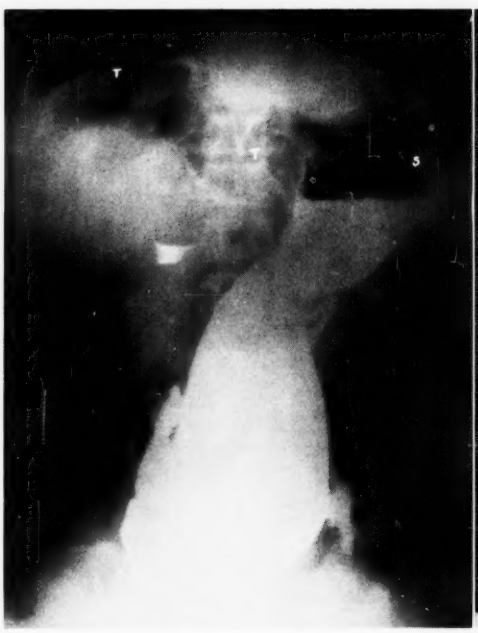

Fig. 7.

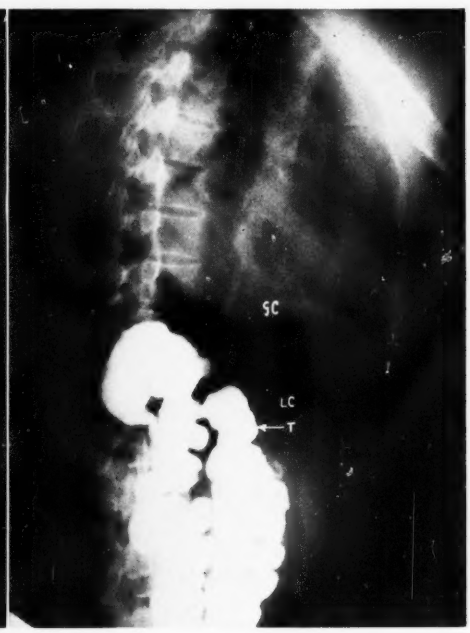

Fig. 8.

Fig. 7. Case 3. Miss F. R., aged 38. Anterior hepato-diaphragmatic interposition of the colon. Note the transverse subdiaphragmatic gas shadow (*T*) due to the presence of the transverse colon between the liver and the diaphragm anteriorly. The stomach is long and low. The air bubble of the stomach is indicated by *S*.

Fig. 8. Case 3. Miss F. R., aged 38. Film made twenty-four hours after the barium meal shows a change in the arrangement of the viscera. The transverse colon (*T*) is now situated below the stomach, and the subdiaphragmatic air shadow is due to air in the stomach which is in volvulus, the greater curvature (*GC*) being uppermost, and the lesser curvature (*LC*) dependent.

firms the suspicion that volvulus of the stomach is present. In the differential diagnosis of total chronic idiopathic gastric volvulus, one must exclude simple high position of the stomach in hypersthenic patients and those cases in which the stomach at first seems high but later assumes its normal position when the full meal is given. One should do colon examination in all suspected cases to exclude simple displacement of stomach by distended colon or to show the presence of an associated or intermittent hepato-diaphragmatic interposition. The importance of this is shown by the fact that of the three cases here presented all had abnormally high colons, two having constant associated hepato-diaphragmatic interposition of the transverse colon and in the third case this condition alternated with the volvulus. In none of these cases was there evidence of gas distention of the colon. In other words, one had the impression that the colon was dragged up by the rotated stomach in Cases 1 and 2, rather than that the colon was responsible for the change in the position of the stomach.

With regard to the production of symptoms, it is debatable whether the volvulus in Case 1 was responsible for symptoms or whether it was simply an interesting accidental finding. In Case 2 it would seem probable, in the absence of any other demonstrable lesion, that the patient's recurring attacks were, in some way, associated with the abnormal position of her stomach. Case 3, however, seems to prove that recurring gastric volvulus may cause repeated attacks of acute epigastric distress, characterized by a feeling of distention and actual slight distention of the upper abdomen. This case also shows that gastric volvulus may undergo spontaneous return to normal position. In this case there was definitely gross abnormality of the mesenteries which were unduly long

Fig. 9.

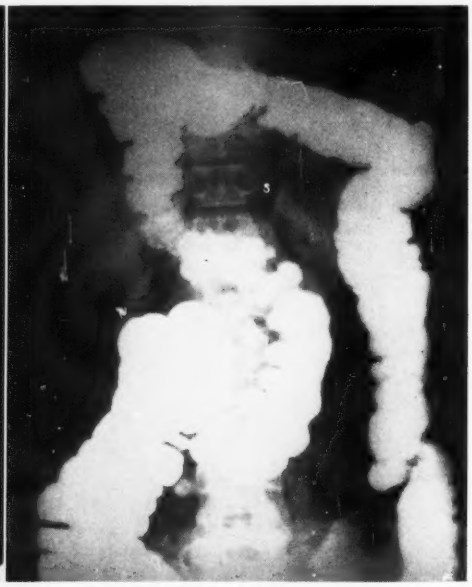

Fig. 10.

Fig. 9. Case 3. Miss F. R., aged 38. Small barium meal proves the stomach to be in total volvulus. The greater curvature (*GC*) is uppermost and the lesser curvature (*LC*) dependent. The transverse colon (*TC*) now lies below the stomach. The pyloric sphincter is indicated by *P* and the duodenal caput by *D*.

Fig. 10. Case 3. Miss F. R., aged 38. Following relief of the patient's symptoms, barium enema shows resolution of the gastric volvulus and a return of the transverse colon to anterior hepato-diaphragmatic interposition.

and thickened, as proven at operation, and which unquestionably allowed of alternating gastric volvulus and hepato-diaphragmatic interposition of the colon. In none of these cases was there any demonstrable local lesion in the stomach or colon or in the surrounding viscera. There was no evidence of diaphragmatic hernia.

CONCLUSIONS

1. Gastric volvulus may be present without producing symptoms or it may produce recurring attacks of mild or fairly acute upper abdominal distress.

2. While the condition is of rare occurrence, the possibility of its presence should be borne in mind in the differential diagnosis of upper abdominal pain.

3. Volvulus of the stomach of 180° may be present without cardiac or pyloric obstruction or strangulation of blood supply and may undergo spontaneous resolution.

4. The probable etiologic factor in total volvulus is an abnormally long gastrohepatic or gastrocolic omentum, or both of these, probably of congenital origin.

5. Two cases of persistent gastric volvulus, associated with hepato-diaphragmatic interposition, and one case of recurring gastric volvulus, alternating with anterior hepato-diaphragmatic interposition of the colon, are presented.

BIBLIOGRAPHY

(1) Azmy, Bey S., and Marey, A.: Volvulus of the Stomach. Am. Jour. Roentgenol. and Rad. Ther., **27,** 420, 421, March, 1932.

(2) Becker: Arch. f. klin. Chir., **140,** 297, 1927.

(3) Berti: Singolare attortigliamento dell'esofago col duodeno seguito da rapida morte. Gazz. med. Ital., **9,** 139, 1866.

(4) Bowen: Volvulus of an Inverted Intrathoracic Stomach Complicating Diaphragmatic Hernia. Am. Jour. Digest. Dis. and Nutrition, **3,** 923–928, February, 1937.

(5) Buchanan, J. (London): Volvulus of the Stomach. British Jour. Surg., **18,** 99–112, July, 1930.

(6) Choisy, R., and Babaiantz, L.: Contribution à l'étude du volvulus de l'estomac. Acta Radiol., **8,** 410–418, 1927.

(7) Deaver and Ashurst: Surgery of the Abdomen. P. Blakiston's Son & Co., Philadelphia, 1921.

(8) Gill: Volvulus of the Stomach. Irish Jour. Med. Sci., **4,** fifth series, 418, 1925.

(9) Kerr: Volvulus of the Stomach. Ann. Surg., **56,** 697, 1912.

(10) Kocher: Ein Fall von Magenvolvulus. Deut. Zeits. f. Chir., **127,** 591, 1914.

(11) Morrison, W. A.: Torsion and Volvulus of the Stomach. Surg., Gynec. and Obst., **52,** 871–874, April, 1931.

(12) Myles, R. B.: Anatomical Variations of the Stomach and Duodenum within Abdominal Cavity. British Jour. Radiol., **10,** 237–260, March, 1937.

(13) Nockolds: Volvulus of the Stomach. British Jour. Surg., **11,** 774, 1924.

(14) Payer: Mitt. a. d. Grenzgeb. d. Med. u. Chir., **20,** 686, 1907.

(15) Rosselet: Contribution à l'étude du volvulus de l'estomac. Jour. de radiol. et d'électrol., **4,** 341, 1921.

(16) Rosselet and Gilbert: Observations radiologique d'un volvulus de l'estomac. Jour. de radiol. et d'électrol., **6,** 76, 1922.

(17) Shanks, S. Cochrane, Kerley, Peter, and Twining, E. W., editors: Textbook of X-ray Diagnosis, **2,** 111, H. K. Lewis & Co., London, 1938.

(18) Thorek: Acute Total Volvulus of the Stomach. Jour. Am. Med. Assn., **81,** 636, Aug. 25, 1923.

(19) Tuffier: Quoted by Tuffier and Jeanne. Le volvulus de l'estomac. Rev. de gynec. et chir., **140,** 297, 1927.

MINIATURE FILMS IN CHEST SURVEYS[1]

By HOLLIS E. POTTER, M.D., *Chicago, Illinois*

MOST of you are roentgenologists. Before discussing the principal topic of this paper I wish each and every one of you could put himself in the position of the modern tuberculosis worker, think as he thinks, and appreciate somewhat the basic facts which determine his attitude toward the x-ray aspects of his case-finding program.

First, remember that although the death rate from tuberculosis has been reduced in recent years, this disease is still the commonest cause of death between the ages of fifteen and forty.

Then contemplate the fact that in the routine general practice of medicine not over 5 per cent of tuberculous cases are diagnosed in a minimal early and easily curable form or stage: 15 per cent are moderately advanced, and 80 per cent are far advanced.

Third, in order to find any high percentage of minimal or early cases widespread surveys are necessary, examining not only the sick or run-down individuals but also those in apparently good health.

Fourth, such surveys have now progressed to the point that 30 per cent of discovered cases are minimal in extent. In certain early cases, in which the tissue involvement is more extensive, it is still more important for their cure that they be recognized at once.

Fifth, the modern tuberculosis worker has finally accepted the x-ray method at its true value. He recognizes it as the one most important factor in diagnosis. Its use is constantly becoming greater.

Sixth, the custom of first throwing out the negative reactors to tuberculin is under severe fire because of a small number of cases which elude the skin test and show positive x-ray findings. More than one prominent tuberculosis worker would drop skin testing at once if he could afford to use the x-ray test on all his cases.

Seventh, in every tuberculosis survey the modern worker is handicapped by lack of funds. He regrets the x-ray expense whether he does the work himself or farms it out to independent roentgenologists. The method is just natively expensive.

Eighth, the high cost of conducting group survey work is well reflected by the recent statement of Dr. Robert Plunkett, general superintendent of sanatoriums in the State of New York. These were approximately his figures: For the age group from birth to fourteen years, inclusive, the cost for finding a case of tuberculosis was over four thousand dollars. From age fifteen to twenty-four, the cost was one hundred and eighty-seven dollars. Each decade showed a decline in cost until, after forty-five years of age, the cost was lowered to seventy-seven dollars.

Ninth, if, now, you can grasp the viewpoint of the group survey worker, you can recognize a crying need for some modification of x-ray technic which will let him go as far and as fast as he desires. If you cannot grasp his viewpoint, you naturally fall back with those who are satisfied to recognize the 5 per cent of early cases and let the uncomplaining chronic open case distribute his infection freely among family and friends.

Tenth, it takes a modern tuberculosis survey man but a few moments to figure that his stipulated budget for skin testing and x-ray service would be adequate if he could omit the skin testing, reduce the per capita cost on all the x-ray negative cases, and have a goodly balance for exhaustive x-ray studies on all positive cases. He is ready and anxious to revamp his case-finding program the minute he finds a cheap and efficient substitute for the present system.

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

Now before outlining something of the detail in the development work and presenting for your appraisal and criticism a system of making miniatures from the fluoroscopic screen which we think may be an adequate answer to the tuberculosis workers' prayer, I wish to define the word "we." It was through the courtesy of Mr. John Clough, the President of General Electric X-ray Corporation, that this work was made possible. It was through the enthusiastic and untiring efforts of certain of his workers that the thousands of experimental operations were carried out. Personally, I attempted to collaborate as an adviser and a critic and now feel it a matter of sheer duty and pleasure to report the results.

You all realize that the idea of making film miniatures by focusing down the image on a fluorescent screen is very, very old. Perhaps 50 per cent of you have failed in doing this at one time or another. The modern machine and the modern tube give an abundance of x-light, but in the screen or in the lens or in the small film itself there has been a woeful lack of efficiency in converting or transmitting this power into the miniature of the size and detailed brilliancy required.

Fortunately, then, the fluorazure screen was made available. This screen, made of zinc sulphide crystals, gives off a brilliant blue-violet light having high actinic values. For general use it is covered with a blue translucent material to reduce a rather pronounced lag. It was found that the factor of lag was not appreciable in making miniatures by projection, so that a special large screen was obtained which is coated with especially large crystals for speed, white in color, and made without the accessory blue overcoating skin for the prevention of lag. This special screen fluoresces with the most intense blue-violet light obtainable to-day. It was mounted in the front of a light-tight box, a yard long, which tapers down to receive lenses or cameras behind. At the back of the screen was mounted a lead glass plate 2 mm. in thickness, to protect the miniature films from x-ray fog. The efficient speed of this screen for the purpose used is about seven times the speed of the ordinary fluoroscopic screen. This whole unit was then counterbalanced on a vertical stand to allow easy adjustment in height.

Early in 1934 Charlton and Dietz, working at Schenectady, began an exhaustive study of the world's most rapid films, their specific sensitivity to the light emitted from various fluoroscopic screens, and their behavior with various developing agents. This work was made available in Chicago. Without going into detail, the amazing fact was brought out that the one film which proved peculiarly sensitive to the blue-violet light of the fluoride or fluorazure screen, while showing excellent working qualities, clear base, and freedom from obnoxious grain effects, was the common commercial x-ray film, the one we use in our regular daily work. Being duplitized, it seems that the lesser exposure of the back emulsion serves to neutralize the grain effect of the front emulsion, so this problem was solved. Using various technics, various films, and developing agents, a series of normal chest films of the 35 mm. size stands as a record of film-selection experiments which we refer to as Series I. With the x-ray film the common x-ray developer was considered adequate.

For Series I, a Contax camera having a lens speed of f 1.5 was used. Some of the results on x-ray film were brilliant. It might be mentioned here that certain workers in foreign countries have actually adopted these 35 mm. films in widespread routine surveys, considering them better than fluoroscopy. It was our impression that they were definitely too small for first-hand reading, and would not stand enlargement without showing a prohibitory amount of grain.

In Series II, a number of normal chest films were made, using an f 2.0 lens capable of covering a two-inch-square miniature. It was realized that for proper chest work a film-screen distance of no less than four feet was advisable and the exposure time should be no longer than a tenth of a sec-

ond. Using these time and distance factors, with 400 milliamperes and proper voltage, the films were definitely thin. Using a fifth of a second they were still somewhat starved and altogether seemed too small for large film substitutes.

Series III. A Graphic camera was then obtained the f 3.5 lens of which would cover a 4 × 5 film. Using 400 ma., four feet distance, and proper voltage, some fairly good films were obtained in half a second. Naturally, they showed motion in the basal pulmonary structures and also they were not as brilliant as desired. We decided right here that miniature films of the chest, to answer well the requirements for case-finding, should be not less than three or four inches in diameter. Speed and yet more speed was necessary, but it must come from the lens. A search revealed the fact that larger and more powerful lenses for this size of film were not commercially available.

Lens manufacturers were consulted, and the calculated requirements for this problem were laid before them. One firm was found who had built to order a lens of this capacity for the purpose of night photography from aeroplanes during time of war. Its speed was f 1.5 and, when wide open, could focus a flat field sharply on a film area three and a quarter inches square.

Series IV. This lens was borrowed and put to work. A series of films of normal chests was obtained which seemed nearly adequate. I believe the prescription was altered to make it especially adaptable to the flat field of the screen and to the character of fluorescent light used. I am sure some exhaustive tests were made on chips of the glass to be used and that the glass selected was proven to suffer no deterioration from stray x-rays during more than a hundred thousand routine exposures.

Series V. Then such a lens was ordered and it required eleven months for completion. It is a six-element, 150 mm. lens, about six inches in diameter, and weighs about twenty-six pounds. It was permanently mounted in the light-tight box and the screen permanently focused on a film in an ordinary holder. This is a painstaking operation requiring actual miniature radiographs of a wire screen. The series of normal chest miniatures then obtained were adjudged adequate for the problem in mind.

Series VI. A practical test of pathologic cases was then undertaken. In this series both films of standard size and miniatures were made. The films of standard size were made at six feet distance in one-twentieth second. The miniatures were exposed both with and without the use of a modern thin Schoenander grid diaphragm. In this grid the opaque elements are so fine and so close together that on the small films the grid lines are not obvious to the naked eye. The pathologic cases were kindly furnished by officers of the Chicago Municipal Tuberculosis Sanatorium. They were chosen to represent various pathologic types and included men and women of considerable adiposity as well as thin adults and children. About sixty-five of these cases were worked up as a laboratory assay of the method.[2]

Series VII is yet to be done. It should properly consist of results obtained in a practical field survey including thousands of cases. It is hoped that some dependable survey group in this country may be induced to undertake such a series in a true spirit of scientific curiosity and make an authoritative report of the results.

Should the miniature method prove acceptable to men now actively making tuberculosis surveys, it will speed up their work enormously. I am led to believe it might aid materially in clearing up some of the general and some of the special questions foremost in their minds. Among the general questions is the contention of Madsen, of Denmark, that more severe cases of tuberculosis develop in those who are tuberculin-negative than in those who give a positive test. If this were true, it would make

[2] In the Scientific Exhibit at the Pittsburgh meeting were shown a large number of these miniatures, together with a smaller number of the films of standard size for comparison.

our present inferences from skin tests look rather absurd. As an example of a special question one might mention the finding, either by a sampling process or by wholesale examination, of those areas in any given city where tuberculosis is most prevalent. The answer to such questions might soon be obtained by a flexible and economical x-ray method.

The outstanding economy derived by use of this miniature method is a reduction of material expense. In cases in which miniatures can be used, the saving is the difference between $650 a thousand and $50 a thousand. Having screened out the infected case, the cost for working it up on standard stereo films would be the same as it is now. Secondary economies in all dark room processes, facility of filing, and decrease in storage space are obvious.

In leaving this subject, I do not wish to give the impression that the work is entirely finished. A high capacity portable apparatus especially designed for this chest work is well under way. Experiments are being carried out which bid fair to increase the speed and efficiency of screen, lens, and film so that a lower milliamperage may be used. The technic to-day is 400 ma., four feet distance, one-tenth second for adults and one-twentieth second for children; double the time with grid; vary voltage two or three kilovolts for each centimeter of chest thickness.

DISCUSSION

DAVID E. EHRLICH, M.D. (New York City): I am limiting my few thoughts to Dr. Potter's paper. I believe we should thank him for giving us all that detailed description of the present work which is going on in that phase of the surveys.

There are several questions that have occurred to me, that have come about during the work we have done with the paper roll method, which it may be worth while asking Dr. Potter about because undoubtedly he has come across them; if he has not, he will. In the first place, about how many of those little x-ray films does he believe he will be able to read per day? In the second place, how transportable is that fluoroscopic unit?

I have many other thoughts that occur to me but those two are practical points which I believe are well worth considering.

CARL C. BIRKELO, M.D. (Detroit, Mich.): I would like to compliment Dr. Potter on what I think is a beautiful piece of work. Those of us who have had something to do with surveys and have had to examine films made from a portable machine or in the offices of general practitioners, will realize how many of such films are technically bad and not diagnostic.

Fluoroscopic surveys have been made and, in the hands of most individuals, they are unsatisfactory. Those of you who have had occasion to see Dr. Potter's work and compare the film made in the usual manner with the miniature film, will see that very nearly all that is in the big film is present in the miniature film, and even if his present set-up is not practical for every one to adopt, it is very much worth while that he has been able to do it. That, to me, is the outstanding feature, and I am glad to again have had the opportunity of hearing his presentation.

HOLLIS E. POTTER, M.D. (*closing*): Dr. Ehrlich asks how many of these miniatures can be read in one day and how transportable is the apparatus. I cannot say how many chest miniatures could be read in a day, but the reading is a bit simpler than when using full-sized films. The little films can be handled with ease because of their size, and the small illuminating box required has a less tiring effect on the eyes, if one is sensitive to light.

The transportability of the special apparatus which houses the lens and screen is about that of a good-sized tube stand. It can be moved about with ease. The x-ray machine required to-day is unfortunately not the mobile, easily transportable type, but a large stationary unit such as is used in heavy diagnostic work. As I mentioned in my paper, there is being developed a new portable apparatus of high capacity for this particular use.

PERICOLIC MEMBRANES

By WILLIAM R. CASHION, M.D., *Brooklyn, New York*

From the Radiological Department, St. John's Hospital

THERE has been considerable controversy regarding the roentgen diagnosis of the so-called "chronic appendicitis." However, the majority of roentgenologists and pathologists state emphatically that such a diagnosis should never be made, or, at least, carefully guarded. It is a known fact that lymphoid infiltration with fibrosis of any area of the body which is infected constitutes a criterion for chronicity of the infection. The appendix contains considerable lymphoid and fibrous tissue in its structure, so where is the dividing line, pathologically, which will classify it as being chronic?

In St. John's Hospital, Brooklyn, the term is avoided not only by the radiologic department, but by the majority of the attending staff. We speak of pericolic membranes, or membranous pericolitis, with a possibly pathologic appendix in cases in which the appendix is present, but if it has been removed, the diagnosis stands without the reference to the appendix. This last statement will be spoken of later.

There are various types of membranes seen and described as being in the right lower quadrant. Of these there are: (1) post-operative adhesions; (2) Jackson's membranes; (3) Lane's bands, and (4) pericolic membranes. All of these are described in surgical textbooks except the last, which are the ones to be considered in this paper.

Pericolic membranes, according to Dr. Duffield (2), "are undoubtedly congenital, and consist of a reduplication of the parietal peritoneum extending up on the side of the cecum and frequently extending around the lower end of the cecum and here having a tendency to shorten the meso-appendix and produce strangulation." He further states, "These membranes may be easily separated by a light touch of the scalpel without any bleeding, as there is a definite line of cleavage."

These membranes were first described by Jonnesco, at about the time of the World War. In 1930, Bigelow (1) published an article in which he reviewed 1,027 cases of his own. Duffield (2) published a concise article in 1932, in which he surveyed 200 cases, about 10 per cent of them having had appendectomies previously. Since this time, there has been a scarcity of literature on the subject, especially as far as the radiologist is concerned.

In the past year, there have been about fifty cases observed by the Radiological Department of St. John's Hospital, Brooklyn. These cases conform fairly closely to the observations made by Duffield regarding age and sex incidence.

The symptomatology of pericolic mem-

Fig. 1. Notice the marked spasm of the prepyloric region of the stomach and duodenal cap. The spasm has been of long standing as indicated by the "mushrooming" of the base of the cap.

branes varies greatly with the age of the individual, but constipation appears to be the predominant factor in most of the cases. The physical type most affected is usually, but not always, the thin, flat-chested individual in whom one would suspect, likewise, enteroptosis. The remaining symptoms are listed in order: (1) right iliac pain and tenderness which is predominant in the younger cases, but diminishes in the older; (2) nausea and vomiting; (3) epigastric pain; (4) flatulency, and (5) digestive disturbances. By the latter we cover the indefinite complaints of epigastric fullness, heaviness, lump in the stomach, etc. The majority of the patients complain on admission of having had recurring attacks of pain with tenderness in the right lower quadrant, frequently made worse on exercise, but never sufficient to cause confinement to bed. The blood count is not elevated and the differential is not shifted. Nausea and vomiting may be associated with the above, as well as a mixture of all the listed symptoms. Some of the patients in the middle-aged group have been diagnosed as having gall-bladder disease or duodenal ulcer.

The roentgen diagnosis of pericolic membranes is based upon observations made by Dr. Knapp, radiologist of St. John's Hospital. They are as follows: moderate to marked pyloroduodenal spasm, relieved mostly by antispasmodics, and with no constant filling defect or niche (Fig. 1); moderate six-hour stomach residue in most of the cases; ileocecal delay due to the acute angle of the terminal ileum on entering the cecum; smooth deformity of the cecum, and spasm of transverse and descending colon, more especially the latter (Figs. 2-*A* and 2-*B*). The smooth deformity involves the outer border of the ascending colon and it appears on the roentgenograph as if encased in an envelope. The cecum is cone-shaped. Haustral markings are absent or very shallow. The appendix may or may not be filled and be in any of the conventional positions. Sometimes these membranes extend upward to the hepatic flexure, and there produce a sharp angulation and reduplication in the region.

Fig. 2-*A*. Fig. 2-*B*.

Fig. 2-*A*. Six-hour examination shows marked stomach retention and spasm. The terminal ileum is dilated and joins the colon at an acute angle. The cecum is cone-shaped and the ascending colon smooth along its outer border, lacking proper haustral markings. The appendix is not visible.

Fig. 2-*B*. Twenty-four-hour examination shows same findings as in six-hour, regarding right lower quadrant. Slight spasm of the descending colon (marked spasm seen in majority of cases). Appendix not visible.

Bigelow, in his article, advocated examination by barium enema. We prefer to give the regular barium meal, for this seems the more logical method of approach to the terminal ileum and cecum under as nearly normal circumstances as possible. The stomach is fluoroscoped at the beginning and the findings noted. In cases of doubt, roentgenographs are taken. The six- and twenty-four-hour examinations, after roentgenographs have been taken, are fluoroscoped as to mobility, separability of parts, and points of tenderness, since these factors cannot be ascertained on the film.

The cases, totalling 10 per cent of those reviewed, which Duffield stated had previously had appendectomies for some reason or other without relief of symptoms, were sent to the radiologic department for gastro-intestinal study, and it was found that they presented the roentgen findings as outlined previously. Secondary operation for removal of these membranes gave the patients complete relief of symptoms, and in a few months they had gained sufficient weight to take care of any enteroptosis, if present. A few had ptosis to such a degree that this condition had to be treated simultaneously. Since Duffield's paper, there have been a few such cases to come under our observation.

Our object in presenting this paper is to stimulate further observation among radiologists of this condition, as we feel that "pericolic membranes" has definite radiologic findings which classifies it as an entity in gastro-intestinal diagnosis.

REFERENCES

(1) BIGELOW, W. A.: A Study of the Cause of Right-sided Abdominal Pain in So-called Chronic Appendicitis: Review of 1,027 Cases. Canad. Med. Assn. Jour., **23**, 22, 23, July, 1930.

(2) DUFFIELD, W. L.: Pericolic Membranes. Ann. Surg., **96**, 98–101, July, 1932.

PATHOGENESIS AND RADIUM THERAPY OF MIXED TUMORS OF THE SALIVARY GLANDS[1]

ILLUSTRATIVE CASES

By ISAAC LEVIN, M.D., *New York City*

THE so-called mixed tumors represent the most difficult and the least understood chapter in oncology. The simplest way, in the opinion of the writer, of conceiving of the genesis of the mixed tumors is to bear in mind their relation to teratomas.

All the other types of malignant tumors are derived from cells of one germinal layer. Even though the cells become de-differentiated, they remain true to type and are morphologically uniform throughout. Sarcoma consists always of one type of mesodermal cells. Carcinoma may appear structurally more complicated since it contains, beside the epithelial cells, a connective tissue stroma; however, this stroma is not actually a part of the tumor but represents a reaction of the organism to the tumor growth.

Mixed tumors develop as a malignant transformation of a teratoma. Since a teratoma contains rudiments of all the three germinal layers, the malignant tumor may develop from all the layers, and, therefore, the tumor appears not uniform in its structure but mixed, with mesodermal cells predominating in one area and ectodermal in another. A mixed tumor of the ovary which develops on the basis of a dermoid tumor is presumably of such a complex character.

More frequently, however, a mixed tumor develops not within a fully developed teratoma but as a transformation of a germinal rest, *i.e.*, a small group of cells which become separated in the early period of the development of the fetus and remain dormant within the fully developed organism. These cells are totipotent, *i.e.*, they have the innate capacity to produce cells of any germinal layer. When a tumor develops from this group of cells it may appear as a mesodermal or an ectodermal tumor, or a mixture of both.

Cohnheim was so impressed by the importance of the totipotent cell rests, in the development of cancer, that he attempted to use this phenomenon in explanation of the general etiology of cancer. In this he failed, but the relationship between the development of mixed tumors through the proliferation of totipotent cell rests remains the most plausible explanation of the pathogenesis of mixed tumors. More particularly is this conception correct as regards the development of testicular tumors and the mixed tumors of the salivary glands. Attempts were frequently made by pathologists to explain the complex morphology of these mixed tumors by metaplasia of adult cells, such as spermatoblasts in the case of testicular tumors, and basal-cell epithelium in mixed tumors of the salivary glands. Krompecher maintained that all mixed tumors of the salivary glands are basal-cell carcinomas and that the spindle- or star-shaped cells or even cartilage found in these tumors develop by metaplasia from epithelial cells. However, such an explanation is much more artificial than the conception that all mixed tumors are derived from germinal totipotent cells. An additional evidence of the correctness of the conception that the germinal rests may be the source of mixed tumors, is the occurrence of salivary gland inclusions in other regions. Figure 1 represents a photomicrograph of a case, observed by the writer, showing a salivary gland tissue inclusion within an epithelioma of the lower lip. The radiosensitivity of these tumors, which will be discussed later, also favors the conception of their embryonic character.

[1] Read at the Thirty-first Annual Meeting of the American Association for Cancer Research, at Atlantic City, May 2, 1938.

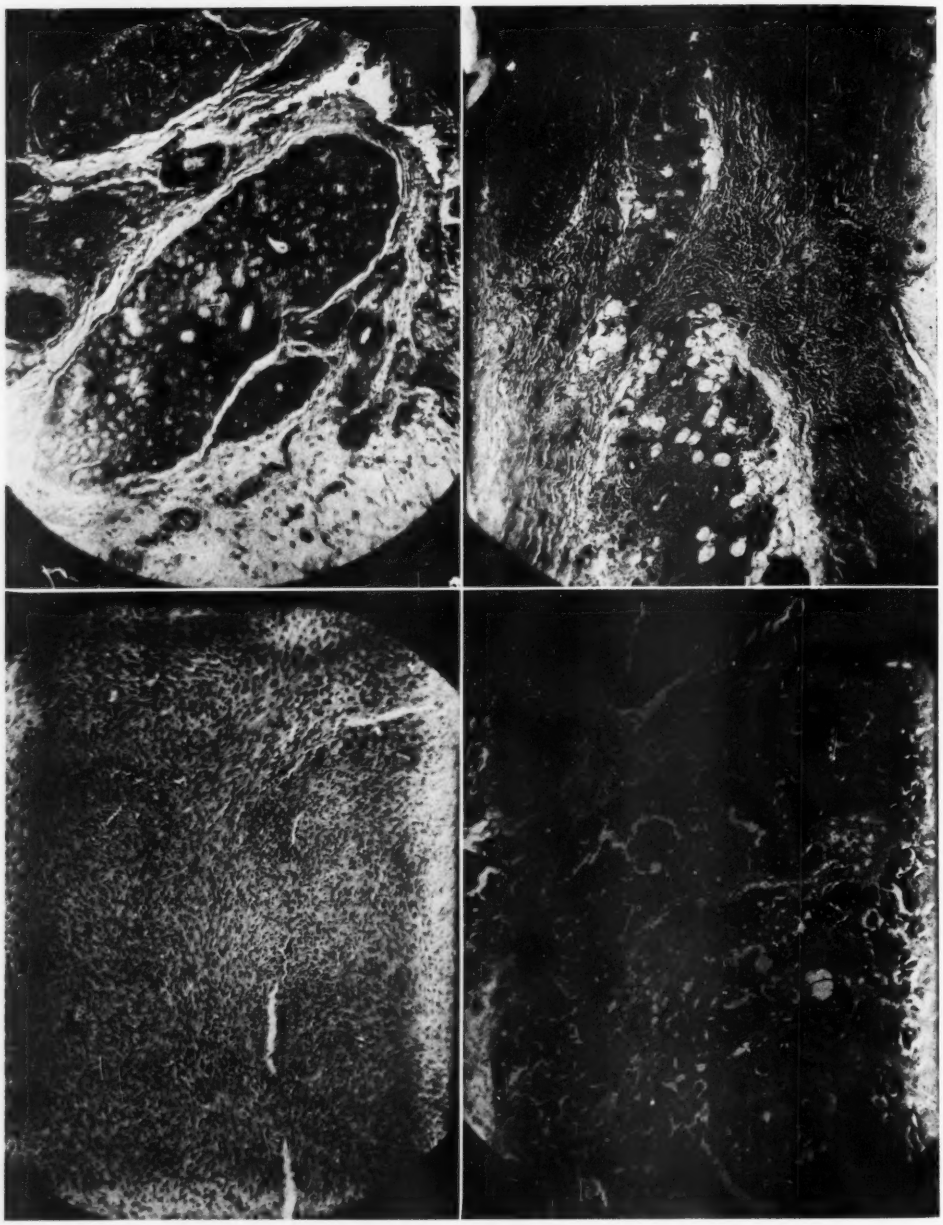

Fig. 1 (*upper left*). Photomicrograph showing salivary gland tissue, inclusion surrounded by epithelioma of the lower lip.

Fig. 2 (*upper right*). Photomicrograph of mixed tumor of the salivary glands. The tissue shows squamous cells surrounded by connective tissue stroma, which is a result of radiotherapy.

Fig. 3 (*lower left*). Photomicrograph of mixed tumor of the salivary glands in which the tissue shows only spindle cells.

Fig. 4 (*lower right*). Photomicrograph of mixed tumor of the salivary glands in which the tissue shows both squamous cells and cartilage.

Pathology.—This presentation is based on an analysis of a series of 26 cases which the writer has selected because he personally studied them from pathologic as well as clinical and therapeutic aspects. In several instances, the tissues studied microscopically were obtained from a biopsy before treatment began and then subsequently from a biopsy obtained when a recurrence took place after treatment. The removed tumors appeared, on gross examination, either soft and elastic, occasionally with a central area of necrotization, or hard and nodular. Microscopically, the tissues presented a combination of various types of cells, basal or squamous epithelial cells, spindle cells and cartilage. Occasionally one may see all those types of cells in one low-power microscopic field. More frequently, however, one type of cell predominates. What is exceedingly important, from the standpoint of the derivation of these tumors, is the fact that, in some instances, the morphology differed in tissues removed from a biopsy taken from the original tumor and subsequently taken from a local recurrence in the same area. The first section may have shown epithelial structure and the subsequent biopsy may show spindle cells or cartilage. In such instances it may be difficult to determine whether the spindle cells are a part of the mixed tumor or represent connective tissue resulting from therapy. Figure 2 shows such a condition. The spindle cells surround the epithelial cells like a stroma and are apparently the result of the treatment. Figure 3, on the other hand, shows the whole tumor consisting only of spindle cells.

Clinical Course.—It is an established fact in cancer that a similarity in the microscopic appearance of two tumors does not imply a similarity in the biologic or clinical behavior of the two conditions. A mixed ovarian tumor behaves like all types of ovarian tumors, grows rapidly to large size, invades the general peritoneum, and forms metastases.

Mixed testicular tumors are morphologically quite similar to the mixed tumors of the salivary glands. Clinically, however, the former is extremely malignant, grows to large size, and rapidly develops huge metastatic tumors throughout the lymphatic course. Mixed tumors of the salivary glands, on the other hand, grow very slowly and frequently remain unchanged for many years, generally seeming to take the clinical course of a benign tumor. However, these tumors have the tendency to recur and such recurrence may take place irrespective of the type of therapy used. In other instances the tumors grow rapidly from their inception, invade and destroy the surrounding tissues, and metastasize in the regional lymph nodes. Thus, while the mixed tumors of the salivary glands resemble, morphologically, the testicular tumors, they usually take a much more benign clinical course which resembles, in many respects, the slow-growing basal epithelioma of the skin. Nonetheless, in the opinion of the writer every tumor of the salivary glands—and 90 per cent of these are *parotid* tumors—must always be considered potentially malignant, since it is impossible to predict when the tumor may take on a malignant course.

Diagnosis.—Tumors of the salivary glands are comparatively infrequent. While some pathologists claim that they may occasionally be classified as benign adenoma or true carcinoma, the greater number of them and the only type which the writer met in his studies, are mixed tumors, and 90 per cent of all these tumors are located either within or intimately attached to the parotid glands. The clinical diagnosis of a parotid tumor presents no difficulties. Epidemic parotitis (mumps), simple parotitis, or suppurative parotitis are easily distinguished by the symptom-complex and clinical course. It is more difficult to determine in each individual case whether we are dealing with a so-called benign or malignant type of tumor. When a tumor in the region of the parotid gland appears diffuse, firmly adherent to the underlying structures, and a facial paralysis, ulceration of the skin, or metastases in the regional lymph nodes is

present, the diagnosis is self-evident, but such a condition is far advanced and beyond therapeutic help. In the earlier stages, the clinician has to depend on the history that the tumor, which may have been stationary for many years, suddenly began to grow rapidly and to cause pain. It is impossible to differentiate, by inspection or palpation, between a comparatively benign or malignant condition, and even the microscopic pictures may be identical. As was stated above, there is no qualitative difference between a benign and malignant parotid tumor. The difference is only in the tempo of the cell proliferation. In view of all of this, every parotid tumor is potentially malignant.

The correct diagnosis of a mixed salivary tumor of the submaxillary gland may be obscured by the fact that malignant lymphoma or lymphosarcoma of the submaxillary lymph nodes is more frequent than the tumors of the salivary glands. They are situated in the same region and cannot be differentiated clinically. Only a biopsy can determine the true condition. Radiotherapy may assist in the diagnosis since it gives more prompt results in tumors of the lymph nodes. The correct differential diagnosis in this location is of great importance, since the ultimate prognosis is much more favorable in tumors of the salivary glands than in lymphosarcoma. The following case may illustrate this condition.

Case 1. A. G., male, aged 69, was seen by the writer on June 20, 1928, with a history of having noticed a lump on the left side of the neck about three months previously, which had grown rapidly since then. In May, 1928, an incision was made over the swelling in another hospital, but this did not influence the condition.

On examination a tumor mass was noted, about three centimeters below the border of the left mandible. It measured about ten centimeters in diameter, was hard in consistency, firmly attached to the underlying structures, particularly at its inferior border, but not to the skin. Over the tumor there was noted a horizontal linear scar about two centimeters in length, and next to it anteriorly, an ulceration. Two discrete, free, movable lymph nodes were palpated in the right submaxillary region. No other abnormality was noted elsewhere by clinical or roentgen examination. A clinical diagnosis of lymphosarcoma of the submaxillary lymph nodes was made, and surface applications of radium were given without any therapeutic effect. This lack of response to radium therapy indicated that the diagnosis of lymphosarcoma was not correct. In September, 1928, a biopsy was taken which showed a mixed tumor of the submaxillary salivary gland with squamous cells predominating. Radium seeds were then inserted throughout the tumor. Another biopsy and radon insertion was done in April, 1929. The tissue taken at the second biopsy showed, beside squamous cells, cartilage (Fig. 4). The tumor diminished in size considerably after treatment, and when the patient was last seen the improvement was continuing.

Therapy.—A therapeutic measure in order to be effectual must take in consideration the clinical course of the disease. Mixed tumors of the testis or ovary rapidly disseminate throughout the abdominal cavity. Therefore, in these conditions the surgical removal of the testis or ovary must be immediately followed by an intensive course of radiotherapy. Since the fields to be treated are very large, reliance must be placed mainly on deep roentgen therapy, unless a radium bomb is available. The first course of therapy must produce the complete therapeutic result since a recurrence or further spread of metastases cannot usually be influenced by radiotherapy.

Mixed tumors of the salivary glands, on the other hand, as stated above, develop slowly and rarely produce distant metastases, but continually recur and ultimately kill the patient by local destruction of vital tissue. The methods of treatment employed by the writer are as follows: The first step consists of the surgical removal of the tumor, which serves both as a diagnostic method and a therapeutic measure. The major portion of the tumor is excised

but no attempt is made at total removal, since this would be followed, in the parotid gland, by paralysis of the facial nerve. Moreover, even in the apparently encapsulated tumors some areas are usually found, at the operation, in which the tumor diffusely penetrates into the surrounding normal tissues and cannot be completely removed. Therefore, surgical removal unaccompanied by radiotherapy is generally followed by local recurrence. The writer immediately follows the operation by insertion of radon capillaries into the operative field (from four to eight capillaries, each containing 1 mc.). The wound is then closed, and this procedure is followed by surface application of small blocks of radium (about 100 mc.-hours at each treatment). No attempt is made at intensive treatment and since the total field is small no deep roentgen therapy is used. This method of therapy does not disturb the surrounding normal tissues and makes it possible to repeat the same treatment, as soon as recurrence takes place, with or without an additional biopsy. The following case may illustrate the efficacy of this method of treatment.

Case 2. S. R., male, 85 years of age, was seen by the writer on March 4, 1926, with a history of having noticed a swelling below the right ear about six years previously, which of late had begun to increase in size.

On examination a tumor mass was found situated below the right ear. It was irregularly round in outline, hard and nodular to palpation, and not adherent to the skin. A clinical diagnosis of mixed parotid tumor was made. On March 12, 1926, an incomplete excision of the tumor was done, capillaries of radon were inserted throughout the tumor bed, and the wound closed. A temporary facial paralysis developed after the operation, which gradually cleared up. Microscopic analysis of the removed tissue showed epithelial spindle cells and cartilage. The tissues around the operative field were indurated at first but soon became soft and pliable. On Feb. 21, 1927, the patient died of a cerebral hemorrhage. An autopsy was performed and a gross and microscopic analysis of the tumor-bearing area of the right parotid gland showed the absence of any neoplastic tissue.

Case 3. G. N., male, aged 50, was seen by the writer on April 16, 1927, with the following history: About 25 years previously the patient was struck on the face and immediately noticed a small lump behind the right ear. This lump remained stationary until one year before examination, when it began gradually to grow.

On examination a tumor mass which began at the right temporomandibular articulation and extended backward to the mastoid process was noted. The tumor was irregularly round in outline, and measured about five centimeters in length by three centimeters in width. It was hard and nodular to palpation, freely movable over the underlying structures, but firmly attached to the skin. A diagnosis was made of a mixed tumor of the parotid gland. On May 9, 1927, a partial excision of the tumor and insertion of radon capillaries was done. This was followed by surface application of radium. On Oct. 17, 1927, the operative procedure was repeated. Microscopic appearance of the removed tissue was similar on both occasions and consisted of squamous-cell epithelium and spindle cells. Since the last treatment there was no evidence of any recurrence.

Case 4. M. M., male, 52 years of age, was seen by the writer on March 9, 1928, with the following history: About two years previously, the patient noticed a swelling under the right ear which gradually increased in size and began to cause pain. He went to a hospital about one year later, where he was operated upon, but the wound did not heal and the swelling continued to grow larger and become more painful.

On examination there was noted in the region of the right parotid gland a tumor mass which extended from the zygomatic process to the angle of the mandible and from the lobule of the ear 5 cm. backward and 5 cm. forward. The lobule of the ear

appeared pushed upward and forward. The tumor mass was irregularly round in outline, stony hard, and nodular in consistency. The skin over the mass was discolored and reddened, and immediately below the ear two ulcerations of the skin exuding serosanguineous fluid were present.

A clinical diagnosis of an advanced malignant mixed tumor of the parotid gland was made. On May 9, 1928, a partial excision of the tumor was done, followed by insertion of radon capillaries. This procedure was repeated in July and again in October, 1928. Distinct diminution in the size of the tumor took place with healing of the ulceration in the skin.

Case 5. A. P., female, aged 44, was seen by a writer on Dec. 13, 1926, with the following history: About 17 years previously, the patient noticed a small pea-sized swelling on the left side of the face, situated just in front of the ear. About 12 years later it began to increase gradually until it reached the present size. Since then the patient began to feel pain, particularly on mastication.

On examination there was noted on the left side of the face in the region of the parotid gland a tumor mass, irregularly round in outline, measuring about four centimeters in diameter. It was firm and elastic in consistency, freely movable, but at one point adherent to the skin. A diagnosis of mixed tumor of the parotid gland was made. On Jan. 10, 1927, a partial excision of the tumor was done, accompanied by insertion of radon capillaries. This was followed by surface application of radium. The tumor diminished to one-sixth original size and remained stationary until the middle of 1930, when it again became active and grew larger. On Sept. 30, 1930, a partial excision and insertion of radon capillaries were repeated. Only a minute area of hard neoplastic tissue was left after this operation and the condition remained stationary for six years, when again it became active and a tumor mass about one and one-half centimeter in diameter developed. On Dec. 3, 1936, a partial excision of the tumor and insertion of radon capillaries were repeated. Since then the tumor has completely disappeared, and when the patient was examined on April 6, 1938, there was noted a soft pliable scar and no vestige of infiltration in the subcutaneous tissue.

SUMMARY

This report is based on a series of 26 cases of mixed tumors of the salivary glands which the writer had the opportunity to study personally from the pathologic, clinical, and radiotherapeutic standpoints.

The most plausible conception of the derivation of mixed tumors is the sudden proliferative activity of the totipotent cells of the so-called "germinal rests."

In view of this derivation, it is evident *a priori* that mixed tumors must be radiosensitive and this accords with the results obtained in practice.

Unlike the mixed tumors of the testis and ovary, the mixed tumors of the salivary glands develop slowly and frequently take a benign course, but the fact that they usually recur after both surgery and radiotherapy, and that they suddenly acquire a very malignant course without any change in the microscopic appearance of the tissue, indicates that every mixed tumor of the salivary gland must be considered potentially malignant, and treated accordingly.

The slow tempo of growth of these tumors obviates the necessity of highly intensive treatment. Furthermore, it is necessary to take particular care of the surrounding normal tissue in the course of radiotherapy so as to make it possible to repeat the treatment when the tumors recur.

The therapeutic technic used by the writer consists of the following: Incomplete excision of the tumor accompanied immediately by insertion of radon capillaries into the operative field, and subsequently aided by surface application of small blocks of radium.

It is not feasible to consider the ultimate results of therapy, statistically setting a

limit of years in these mixed tumors. As was noted in Case 5, recurrence took place 11 years after the beginning of the treatment. In this connection it is interesting to note that the writer found the most resistant tumors those that show cartilage microscopically.

There were several indications, however, in the cases studied, which show the efficacy of the methods of therapy employed by the writer. In Case 2 an autopsy was done 11 months after the beginning of the treatment and no tumor tissue was found anywhere. In Case 4 the ulcers of the skin created by the tumors were healed. With few exceptions, in the cases studied, the tumors shrank promptly after treatment.

CONTRIBUTORY NEGLIGENCE AS IT APPLIES TO MEDICAL MALPRACTICE

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IN previous papers I have tried to stress the importance of keeping careful records and the advisability of giving concrete, adequate directions and instructions to patients, their attendants, or those responsible for them.

Possibly I have dwelt so persistently upon these subjects that some of my readers believe their importance has been overestimated; but anyone who has made a serious study of malpractice litigation cannot fail to realize the great importance of these two items of medical practice, and to have their gravamen brought home to him in the most forcible manner. We must recognize that failure in their observance has been the principal cause and the soundest basis of a great number of malpractice suits, of many verdicts and judgments for large sums of money, and many seriously damaged reputations.

It must be obvious to all, that whenever clear, definite, and adequate instructions and directions are given by a physician to his patient or to his attendants, which they fail to obey to the letter, the therapeutic effect the physician is trying to obtain cannot be expected to be produced. The more clearly detailed and explicit these instructions and directions are, the greater is the opportunity for charging and *proving* contributory negligence in the event that something goes amiss through the patient's neglect in following them.

From a purely medical and surgical point of view, we know that the hearty and active co-operation of patients and those attending them is often essential in order to obtain the best results from our therapeutic efforts; but, when and if the patients or their attendants are not adequately and sufficiently instructed and directed by the physician, only very few of their actions can be construed as contributory negligence.

On the other hand, the more explicit and detailed the instructions and directions, the better are the subsequent chances for charging contributory negligence in case the instructions and directions have not been complied with or observed.

And again, it is a well established fact that patients with tendencies and propensities to bring unjustifiable charges of malpractice against physicians, are possessed of certain more or less definite mental quirks and characteristics which have not been given the attention they deserve. Among these traits are *an apparent resolution not to obey, not to follow instructions and directions* given them by their physicians, and to be alert to make much of the allegation that proper and adequate instructions and directions were not given, and, therefore, to assert and claim that because of such failure to instruct and direct, the allegedly poor results followed, for which damages are claimed. All of us who have been in practice more than a few years have met this class of patient, and not a few have had occasion to remember how costly such omissions may be.

When considering the subject of medical malpractice, nearly all of us think of something that a physician has done that was wrong, or that he, or someone for whom he was responsible, failed to do, that was wrong; all or each of these errors of commission or omission causing someone to be injured in a manner which might be or should be paid for.

While the errors of commission and omission of physicians and dentists make up by far the greater number of torts and civil wrongs which culminate in malpractice suits, there are a considerable number of wrongful acts not done nor left undone by physicians, but which enter into our malpractice litigation. Among the most important of these is contributory negligence.

It is not generally known that the laws

and court rulings governing medical malpractice impose upon every patient having legal capacity, and upon those in charge of patients without legal capacity, the duty of exercising ordinary care to protect themselves against injury. This means, that degree of care and circumspection exercised by the ordinarily prudent person. It does not mean nor require unusual nor extraordinary care, nor does it mean nor require the utmost possible caution.

Failure to observe, or a breach of, this duty constitutes negligence on the part of the patient and if such patient's negligence concurs with the negligence of the attending physician in causing injury to the patient, such negligence constitutes and is called "contributory negligence." So, it is and has been said that contributory negligence consists of any negligent act of the patient, his attendants, or those responsible for his conduct, for which the physician is not liable and which tends to produce a counteracting effect upon his (the physician's) efforts. As its name implies, it is a negligent act of commission or omission which contributes to aggravate an existing condition or prevents its most efficient treatment. Precisely as a physician is deemed negligent in the performance of, or failure to perform, certain acts in connection with the rendition of medical or surgical services, in much the same manner a patient may act negligently and thereby definitely contribute toward a bad or unsatisfactory end-result, which so frequently terminates in a malpractice suit against the physician.

As just stated—but it will bear repeating—contributory negligence may be due either to acts of commission or omission and may be either negligence for which the patient is directly responsible or due to a causal connection between such negligence and the injury of which complaint is made.

Contributory negligence on the part of the allegedly injured patient is, therefore, one of our best and most important defenses, when, as, or if such negligence occurs during the treatment of the case involved.

When the relation of physician and patient has been created, the patient owes a certain more or less definite degree of duty to the physician, as well as care to himself. Because thereof, patients, as a rule, may not recover damages from the physician if the latter can prove that the patient's negligence contributed to the injury complained of, simultaneously with the physician's alleged negligence. Quoting from "Cyclopedia of Law," **30,** 1580: "It is the duty of a patient to so cooperate with his physician and conform to the necessary prescriptions and treatment, and follow all reasonable instructions given. Therefore, it is a good defense to an action for malpractice, when the physician or surgeon is charged with negligence or non-observance of proper care or want of skill in performing the services undertaken, that the patient was guilty of negligence at the time which conduced or contributed to produce the injury complained of."

Examples of cases in which contributory negligence might be successfully charged are those in which the complaining patient failed to follow directions and instructions; acted in a manner so as to prevent or delay recovery; proceeded with or adopted some different course of treatment at the same time and simultaneously with the physician's treatment (like applying a salicylic acid ointment immediately after a liberal dose of x-ray, as I have repeatedly seen); failed to return for observation or further treatment when directed so to do; failed or refused to permit proper treatment, or failed to complete treatment, etc.

In a Kansas case involving an alleged injury from the diagnostic use of x-ray, the verdict in the trial court was given to the plaintiff; but the Appellate Court decided that,

> "The fact that a patient discharges a physician or quits his care and employs another physician is not in itself evidence of contributory negligence . . . There was evidence that the patient had continued under the professional care of the defendant for a long time after the 'burn' was inflicted and that it grew no better, but became continually worse" (92 Kan. R., 801).

Some state supreme courts have decided that the term "contributory negligence" presupposes negligence by the physician which would justify a cause for suit *except* for the simultaneous and concurrent contributory negligence of the patient. In those States, the defense of contributory negligence admits, by inference, that the physician-defendant was negligent. Under this theory, if the negligence of either the patient or the physician is the sole direct cause of the alleged injury, there can be contributory negligence.

In other state supreme court decisions, the term "contributory negligence" is used to indicate not only instances in which simultaneously concurring negligence has taken place on the part of both patient and physician, but, also, instances in which the patient's negligence was the sole, direct, or immediate cause of the alleged injury. It has been held by able jurists that if any negligence on the part of a patient preceded, simultaneously concurred in, or occurred after the negligence, if any occurred on the part of the physician, *contributory negligence is a complete defense.* Stated otherwise, negligence of a patient is a complete and competent defense to malpractice on the part of a physician when it is connected with, concurs in, and is simultaneous with, the negligence of the physician. Naturally, this must be the true and correct conclusion, because in so many instances physicians may be and are called upon to treat injuries caused by the negligent action or conduct of the injured person. In such situations the injured persons cannot recover for damages resulting directly from the original injury *per se*, but may recover under these conditions and be given a verdict because of the aggravation of the condition blamable to the physician's negligence.

Again, if the negligence of the patient ensues or follows the negligence of the physician, the patient's negligence will not help to defeat a malpractice suit; but, at the same time, the patient will not—or perhaps we better say should not—be able to secure a verdict against the physician because of alleged aggravation of the injury if such aggravation itself was the result of his own (the patient's) negligence. This is illustrated in a Wisconsin decision[1] in which the plaintiff claimed damages because of alleged negligence in the treatment of a fracture of the femur, plaintiff having been under the physician's care in a hospital for six weeks, the end-result being union in an overriding position and shortening. Proof was presented that the patient left the hospital too soon, failed to obey instructions, and, thereby, caused aggravation of the injury and increased the deformity.

The following short excerpts from some decisions and briefs will more clearly elucidate what the courts think relative to contributory negligence, as regards medical malpractice.

"It is not the duty of the injured person to submit to a serious surgical operation for the purpose of effecting a cure. . . . . Contributory negligence to defeat a right of action must be simultaneous and co-operating with the fault of the defendant, must have entered into the creating of the cause of the action and have been an element in the transaction which constituted it." Leadingham *vs.* Hillman (Ky.), 5 S. W. R. (2nd), 1044.

"Failure to notify physician of marked change in wife's condition when instructed so to do, establishes charge of contributory negligence." Sprouse *et al. vs.* Magee (Idaho), 269 Pac. R., 993.

"The cause of action for the physician's negligence may be complete and accrue before the negligence of the patient comes in to aggravate the result. When it does occur its consequences go in mitigation of damages, not in bar of the action." Schultz *vs.* Tosche, 166 Wis. R., 561; 165 N. W. R., 292.

"A physician may be called in to prescribe for cases which originate in the carelessness of the patient; and though such carelessness would remotely contribute to the injury sued for, it would not relieve the physician from liability for distinct negligence, and the separate injury occasioned thereby. The patient may also, while he is under treatment, injure himself by his own carelessness; yet he may recover from the physician if he carelessly or unskillfully treats him afterward, and thus does him a distinct injury. In such cases, the

[1] Schultz, *vs.* Tosche, 166 Wis. R., 561; 165 N. W. R., 292.

plaintiff's fault does not directly contribute to produce the injury sued for." Hibbard *vs.* Thompson, 109 Mass. R., 286.

In deciding that there could be no recovery in a malpractice suit, the Indiana Supreme Court said in part:

"But if a surgeon, when thus called upon advises the patient who is of mature years and of sound mind that the operation was unnecessary and improper, in short, advises against the performance of the operation . . . we do not see upon what principle the surgeon can be held responsible to the patient for damages on the ground that the operation was improper and injurious." Gramm *vs.* Boehmer, 56 Indiana R., 497.

In North Dakota, the Supreme Court decided as follows, on the aspect of malpractice:

"If a person is fully cognizant of the nature of the specific treatment that he is about to get, or if he actually directs a specific act, such as an operation which should not be performed, it would seem that he could not properly complain later that such an act constituted malpractice for which he should recover. Here it would seem that he has sought to rely on his own judgment rather than that of the physician and can complain only if the physician negligently performed the act or treatment that the patient complained of." Halverson *vs.* Zimmerman (N.D.), 232 N.W.R., 754.

An Ohio court in a malpractice suit, gave the jury the following approved instruction:

"Even if you find that no instructions were given to the plaintiff, yet the plaintiff would be required to use and exercise such ordinary prudence and care in the use of and treatment of his injured limb as would be expected of one not having special knowledge of what would be required of a person in his condition; and if he did not do so, but, on the contrary, was careless and reckless in the use of his injured limb, before it was sufficiently strong to be used, and that use contributed to the injury of which he complains, he cannot recover in this action, and your verdict should be for the defendant." Fish *vs.* Walker, 7 Ohio N.P., 472.

Even if the treatment prescribed by the physician causes pain or disagreeable immediate effect, a patient is not justified in disregarding the instructions and directions. This is brought out by the following:

"Nothing can be more clear than that it is the duty of the patient to co-operate with his professional adviser, and to conform to the necessary prescriptions; but if he will not, or under the pressure of pain cannot, his neglect is his own wrong or misfortune, for which he has no right to hold his surgeon responsible. No man may take advantage of his own wrong, or charge his misfortune to the account of another." McCandless *vs.* McWha, 22 Pa. R., 261.

Failure to have roentgen examination made is a part of the defense in the following case:

"A patient, when he places himself in the care of a physician, cannot decline to follow his advice nor adopt his suggestions because the patient does not possess full knowledge of the dangers involved in his neglect, or in his failure to do what the physician recommends. The patient cannot charge the physician with negligence if the patient himself refused to carry out the directions because ignorant of the consequences which might result from such failure. The patient may fail to understand fully the necessity of doing what the physician recommends, but he cannot attribute to the physician the damages which resulted from his own failure to have something done, when this was caused by his own neglect, even if he was ignorant of the consequences which would result from his refusal.

"If the x-ray photograph was not taken because of the plaintiff's refusal, the defendant cannot be charged with negligence in this respect. He was responsible to the plaintiff for the failure to use care and skill of an ordinary practitioner in the community where he practised his profession. If such photograph was essential in order to discover the fracture, and the physician in the exercise of that degree of care required of him, advised that it be taken and the patient refused this advice, the physician cannot be charged with negligence. The plaintiff cannot hold the defendant responsible for the consequence of his own want of care, nor attribute to him damages resulting from his own neglect; and he cannot complain if the injury resulted from his refusal to follow the advice of the attending physician." Carey *vs.* Mercer, 239 Mass. R., 599; 132 N.E.R., 353.

Failure of the plaintiff to return to his office was presented as contributory neg-

ligence; but the Maryland Supreme Court said:

"In the absence of any instructions from the dentist to return for treatment, the plaintiff would not be charged with this omission. . . . . A patient's failure to return for further treatment after discovering he is not improving because of the physician's negligent treatment does not bar recovery for injuries for such improper treatment; and the mere fact that the patient who believes he has been injured by the negligence of his physician, discharges him or quits his care and employs another is not in itself evidence of contributory negligence." McClees *vs.* Cohen, 158 Md. R., 60; 148 Atl. R., 124.

Defense of a malpractice suit on the grounds that plaintiff failed to return for further treatment after complications developed, failed in a case in which the Washington Supreme Court said:

"It is true undoubtedly that if a patient employs a physician to treat him for a malady, and receives careful and skilltul treatment in his office, but fails to return to the office for further treatment before he is discharged by the physician, and in consequence suffers an injury, he is not entitled to recover from the physician for such injury, and it is also true that a physician's liability ceases the moment his patient dismisses or discharges him, if his treatment of the case has been proper up to that time. But these principles have no application when the physician's treatment of the case has been improper. When being improperly treated the patient is at liberty to quit at any time, and he may hold the physician liable for the injuries suffered by him because of the improper treatment, notwithstanding it is highly probable that the physician, had the patient continued his treatment, would sooner or later have discovered that his treatment was improper and would have modified it so as to effect a cure." Williams *vs.* Wurdermann, 71 Wash. R., 390; 128 Pac. R., 639.

Even if no instructions to return are given to an office patient of a physician or dentist, who, the patient knows, does not make outside visits, the patient whose condition is aggravated by his failure to return for further treatment cannot recover in several States, for the aggravated condition which is due solely to his own conduct.

The truth and force of the foregoing statement is well brought out by a paragraph from the decision in a Maryland case as follows:

"If an office patient comes to the office of the physician or surgeon whom he employs and from whom he has received careful and skillful treatment, and then fails to return to the office for further treatment, and in consequence thereof suffers injury, he is not entitled to maintain an action against the physician, because it is his own default and malfeasance." Dashiell *vs.* Griffiths (Md.), 35 Atl. R., 1094.

In Minnesota, a plaintiff was denied recovery of damages, because the unsatisfactory result of correct treatment was not caused by any omission or act of commission by the defendant physician; but was due to the refusal of the patient to submit to a curative operation in an osteomyelitis case. (Nelson *vs.* Parrish, 143 Minn. R., 368; 173 N. W. R., 715.)

A bad result in a fracture case because of patient's refusal to submit to an anesthetic, resulted in a verdict and judgment for the plaintiff; but was reversed by the Missouri Supreme Court. The important part (to us) of this decision reads, "It is clear that . . . negligence of the plaintiff, in the case at bar, if established, would constitute a complete defense." Summers *vs.* Tarpley (Mo.), 288 S. W. R., 266.

Refusal to go to a hospital and failure to employ a competent nurse, with a malunion as the end-result in a fracture of the femur, ended in a suit with judgment for the plaintiff (patient) and against the physician, because the physician's testimony was discredited and *he had no corroborative testimony*. Moore *vs.* Tremelling, 78 Fed. R. (2nd), 821.

"In the event of removal from hospital without knowledge or consent of physician, by patient with multiple fractures, the defendant physician would not be held liable for anything that happened to the plaintiff after she left the hospital." Feltman *vs.* Dunn (S. D.), 217 N.W.R., 198.

"The burden of the proof is on the defendant that plaintiff (patient) had been guilty of contributory negligence." Huber *vs.* Hanley (Wash.), 210 Pac. R., 769.

In suits filed in behalf of children, the

fault or contributory negligence of the parent, guardian, or custodian cannot be imputed to the child-plaintiff according to decisions from a great majority of the States. But all the authorities are not in harmony, because of this rule. In an Oklahoma case it was held:

"But by the great preponderance of the adjudicated cases, it is held that the negligence of the parents, guardians or custodian is not imputable to the child, on the ground that it is not and cannot be responsible for the danger to which it is exposed. That it has no volition in establishing the relation of privity with the person whose negligence it is sought to impute, and should not and cannot be charged with the negligence of such person in permitting it to be exposed to a danger it had not the capacity either to know or understand, or to avoid in any manner whatsoever." Atchison, Topeka, and Santa Fe Ry. Co. *vs.* Calhoun, 180 Okla. R., 75; 89 Pac. R., 207.

In a leading New York case, it was held otherwise, because

"An infant is not *sui juris*. He belongs to another, to whom discretion in the care of his person is exclusively confided. That person is keeper and agent for this purpose; and in respect to third persons, his acts must be deemed that of the infant's; his neglect, the infant's neglect . . . , if his proper agent and guardian has suffered him to incur mischief, it is more fit that he should look for redress to that guardian, than that the latter should negligently allow his ward to be in the way of travellers and then harass them in the courts of justice, recovering heavy verdicts for his own misconduct." Hatfield *vs.* Roper (N. Y.), 2 Wendell R., 615.

The negligence of the father could not be imputed to the child-patient in a gun-shot wound malpractice suit. On the defendant's first visit to the plaintiff (patient), after dressing the wound, the child's father was instructed to call the defendant if everything was not all right. Several days elapsed before the defendant was called. The end-result was a badly deformed foot. Suit was brought against the physician and contributory negligence was claimed as a defense. This the court denied, because the father's negligence could not be imputed to the child. The court said:

"An adult person, when he commits his person to the custody of another, does so at least voluntarily; an infant does not select his custodian—it is selected for him by the laws of Nature, or by circumstances beyond his control. Certainly, there is no reason why the ordinary principle that, where one is injured by the concurrent negligence of two persons, he has an action against neither or both, should not apply in the case of an injury to a child, unless the imputation is to be put upon the law of denying the feeble and helpless infant the same measure of protection which it accords to an adult." Mullinax *vs.* Hurd, 174 No. Car. R., 609; 94 S.E.R., 426.

From my study of hundreds of cases of medical malpractice, it is my opinion that contributory negligence, as a defense weapon, is not utilized by the medical profession and by the legal profession when defending the medical profession, to anything like the extent it should be. It is generally a good defense, even if used in cases in which the physician has actually been guilty of negligence; in which it is often a potent element and factor in reducing and, in a considerable measure, mitigating the damages that might be awarded. The law and the defense of malpractice suits reason somewhat differently than do we in the treatment or diagnosis of disease. Here, in the defense of malpractice suits, any and all possible means for minimizing and rebutting the testimony and evidence of the other side of the case, must be and are used toward securing the verdict for our side of the suit.

Finally, it is well for us to remember, and to bear constantly in mind that the legal implication is, that the *patients know practically nothing as to their own proper conduct in connection with injury or disease.* Consequently, it becomes a part of our legal duty to instruct them in these respects; but it must also be remembered that, once having been properly and clearly instructed, it becomes equally obligatory for the patients to follow faithfully and conform to these instructions. Failure to follow the instructions is and should be construed as and charged as contributory negligence.

FIRST MEASUREMENTS WITH THE SPANISH STANDARD FOR THE ABSOLUTE DETERMINATION OF THE INTERNATIONAL ROENTGEN UNIT[1]

By H. TELLEZ PLASENCIA, M.D., Delegate of Spain to the Fifth International Congress of Radiology

THE Laboratory for Radiological Measurements annexed to the Service of Physical Therapy, directed by the author, began operation in 1931. In 1932, there was installed a Piccard compensation electrometer, with which we began to make determinations of the charge of radium containers. Finally, in 1934, we found it possible to adapt to this installation the standard chambers for the absolute measurement of the roentgen unit. Varied circumstances until now have hindered our comparing this standard with the standards of other countries, but it will be done as soon as possible.

The arrangement we have employed has been adjusted to the agreements of 1934 between the National Laboratories (1).

I.— X-RAY GENERATOR

We have employed one of the constant high tension machines—"Stabilivolt" S.R.-V.—in our Department of Roentgen Therapy. The feeder line presents fluctuations of voltage which, up to this time, we have not found the means of compensating for, by the use of a voltage stabilizer, but we hope to do so in the future, when our equipment will operate as a public service of standards. Notwithstanding, we have practically eliminated these unpleasant oscillations by making our measurements during the hours in which the industrial engines are stopped. In every case, the filament current has been furnished by a storage battery having a capacity of 100 ampere-hours.

We have employed two x-ray tubes: one of the Multix model, for voltages up to 110 kv., cooled by thermosiphon, and entirely protected against loss of radiation. The other, of the Metwa Matalix type, up to 200 kv., having the same cooling and protecting system as the former, and a glass window for the passage of the rays. These models are not shockproof, but our new tubes will be so protected in the future, on account of the very efficient screening that the shockproof tubes and conductors possess, which renders unnecessary every other protection against interference from magnetic fields.

The milliammeter for measuring the intensity of the current passing through the tube has been calibrated against a precision instrument. We have marked only a fixed point, corresponding to the reading of 4 ma. A second milliammeter, in series with the first, checks the constancy of its readings. The margin of error in the current measurements is of the order of 2 per cent.

The high voltage of the Stabilivolt generator has been calibrated by means of a Müller sphere gap, with spheres of 125 mm. diameter. The connection of the spheres with the high tension line has been made through high ohmic resistances, formed by 6 meters of glass tubing of 1 cm. diameter, rolled in a spiral and filled with 95° alcohol. The spark obtained in the sphere gap is very fine, and is spontaneously interrupted, affording periodical discharges (relaxation oscillations).

The accuracy of the sphere gap has been verified by means of a Seemann spectrograph for voltages of 100, 140, and 180 kv., corresponding to minimum wave lengths of 0.125, 0.088, and 0.0686 Ångström unit. When the spectra are obtained with the time of exposure long enough to obtain a good blackening, the accuracy of the minimum wave length band is sufficient to allow the reading to the third decimal figure, in the enlarged spectra. This method gives us a good control of the data contained in the explosive spark gap tables.

[1] Presented before the Fifth International Congress of Radiology, in Chicago, Sept. 13–17, 1937.

As a secondary test of the high voltage, a voltmeter has been connected to the terminals of the primary transformer. The current in the tube was invariably 4 ma.

II.—GENERAL ARRANGEMENTS FOR THE IONIZATION MEASUREMENTS

The method we have employed for the ionization measurements is, along general lines, the following:

The standard chambers are two, of different models, I and II (Figs. 1 to 4); their ionization current can be measured simultaneously or separately. For the standard measurements of small chambers, one of the standard chambers is taken out, and the small one is checked with the other, by the method of simultaneous measurement.

The measuring electrodes, *a*, of both chambers communicate, through the protected conductor, *1* (Figs. 5 and 6), with the string, *2*, of the Piccard electrometer, which is also connected to the inner electrode, *3*, of one of its own spherical chambers, *4*. The other has been replaced by a piezo-electric quartz sheet, *5*, which is the primary standard of quantity of electricity.

When the standard chambers receive the beam of x-rays, the ionization current flowing in them is compensated for by the one flowing in the opposite direction in the spherical chamber *4*, under the action of a radium tube *6*, the distance of which to the sphere *4*, can be varied by means of a micrometric device *7*. When the opposite ionization currents are exactly compensated, and the string *2*, remains still, we have in the chamber *4*, a constant current, easily calibrated, in absolute units, and equal—except for the sign—to the current of the standard chamber.

The calibration with the standard of quantity is very simple. Owing to the well-known property of the piezo-electric quartz, a well-defined quantity of electricity is set free in the plate *9*—the other plate *10*, being connected to the ground—when a weight is put on the scale *8*. We have only to measure the time at the end of which this quantity has been entirely transported by the ionization current, *i.e.*, the string, *2*, is turned to its starting point. The intensity of the current is given by the rate quantity/time.

The method is extraordinarily simple, and has the great advantage of avoiding the use of resistances and capacities whose values must be exactly calculated, as they enter in the formula giving the absolute measurement, and whose delicacy renders their use and preservation difficult. On the contrary, the piezo-electric quartz is one of the most stable and robust standards; the measurements made with it are really absolute ones, the only functions of the fundamental variables *mass*, *time*, and *length*. Finally, it is totally unnecessary to calibrate the electrometer, which plays no other part than that of being an index of discharge. Therefore, its sensitivity does not need to be very great, and the changes in the capacity of the system have no influence whatever on the results of the

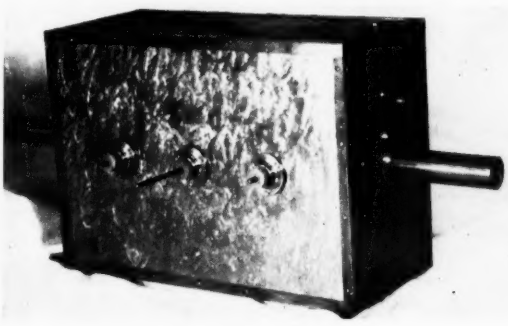

Fig. 1.

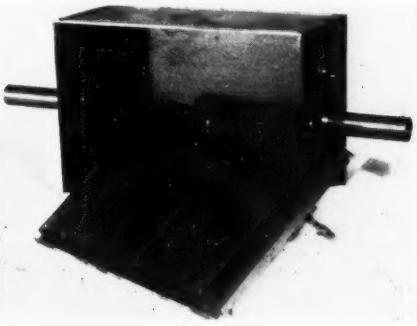

Fig. 2.

measurements: they only change the sensitivity of the electrometer. In this way the two most serious difficulties of the electrometric methods are eliminated. It is also important to have good insulation.

III.—CONSTRUCTION OF THE STANDARD CHAMBERS

Having chosen the methods proposed by Küstner under the name of "*Dreielektrometerverfahren*" (2), we have preferred not to prepare a primary and a secondary standard, but two primary standards of different models, in order to compare the two principles proposed by different authors: the parallel plate electrodes chamber, and the so-called "barrel" chamber.

Our two chambers are of brass, 2.5 mm. thick, covered with 1 mm. of lead. Chamber I (Figs. 1 and 2) is of the "plate electrodes" type, identical with that employed by Otto Glasser and U. V. Portmann (3). The exterior dimensions are 14 × 22.2 × 31.9 cm. The electrode, *d*, has a surface of 270 × 200 mm. The measuring electrode, *a*, has dimensions of 50.5 × 200 mm.; those of the guard electrodes, *b* and *c*, are 110.5 × 200 mm. for each one.[2] The distance between the measuring and the guard electrodes is 0.7 mm. The distance between the two parallel planes, *d* and *a*, *b*, *c*, is exactly 99.9 mm.

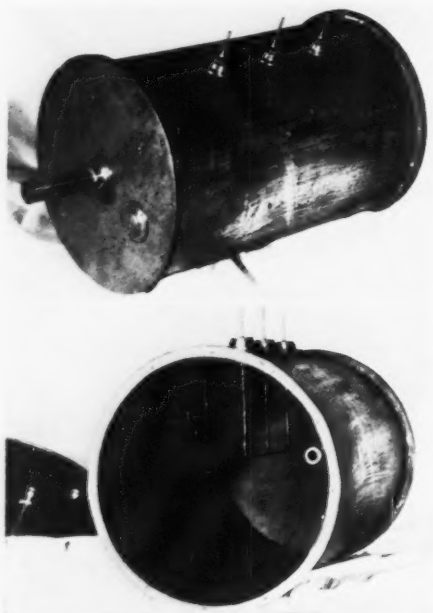

Fig. 3 (*upper*). Fig. 4 (*lower*).

The surfaces of the electrodes and of the box are covered with a graphite varnish 0.5 mm. thick. The connection of the measuring electrode, *a*, to the main conductor *1*, is insulated with pure natural amber; for the other electrodes, the insulators are of agglomerated amber, the dielectric power of which is still very great. The cylinders which support the electrodes parallel to the exterior walls are also of pure amber for the measuring electrodes, and of agglomerated amber for the others. The distance between the electrodes and the walls is 176 mm.

The chamber diaphragm *11*, has a diameter of 7.85 mm. and a thickness of 5 mm. The hole is a cylindrical one, and has been calibrated with precision standard plug gauges.

The volume of ionized air, the electrons of which reach the measuring electrode, is that of a trunk of a cone, and is given by the product of its mean cross-section by the effective length, *l*, of the measuring electrode, according to the formula (4)

$$V = \frac{\pi D^2}{4} \times \frac{L^2}{F^2} \times l$$

in which D is the diameter of the chamber diaphragm *11*, F the distance from the focus to the surface of the same diaphragm, and L the distance from the focus to the center of the measuring volume.

The distance F was measured by means of a rigid metal stick, the length of which is equal to the distance F minus the distance from the focus to the window of

[2] The length of the guard electrodes is relatively small, according to the rules established by Failla; the minimum length should be 15 cm. That is also true for our cylindrical Chamber II. Our Chamber I was constructed in 1928 and our Chamber II in 1930; that is the reason why they are not constructed according to the latest requirements. But we have not wished to make any change in their construction until the day in which we shall have the opportunity of comparing our standard with those of other countries.

the x-ray tube. This last distance was exactly determined by obtaining by radiography the two lead points placed on the three bakelite cylinders, and their surface, like that of the inner wall of the chamber, is covered with a graphite varnish 0.5 mm.

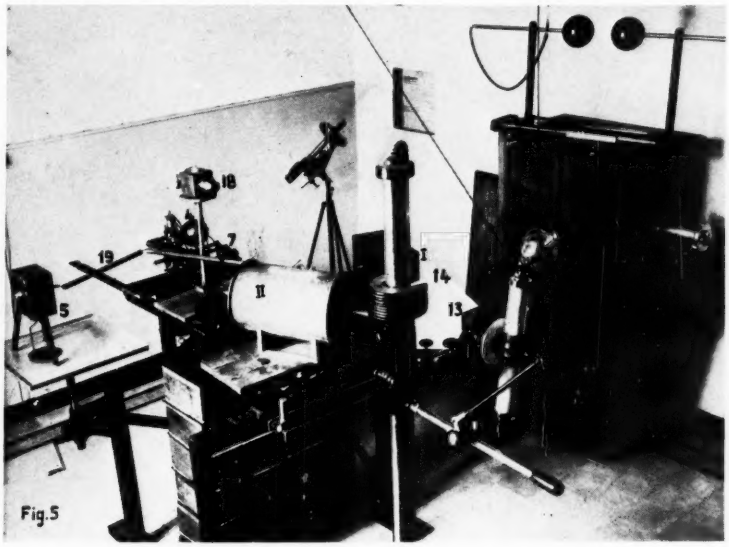

Fig. 5.

glass window, which are at a given distance from one another on a film situated 5 cm. from the glass. The radius of the tube is then given by a single comparison of similar triangles.

We have chosen, as value of the distance F, the length of 100 cm. The accuracy of the measurement has a margin of error of not more than ± 0.5 per cent.

The length, L, is equal to F plus half of the length of the chamber, which is entirely symmetrical. Its value is 128.15 cm. The ionized measuring volume is, therefore,

$$V = \frac{3.1416 \times 0.785^2}{4} \times \frac{128.15^2}{100^2} \times 5.05 =$$

$$V = 0.484 \text{ cm.}^2 \times 1.6422 \times 5.05 \text{ cm.} =$$
$$V = 4.014 \text{ cm.}^3$$

The other Chamber II (Figs. 3 and 4) is a cylindrical one, very similar to the free air chamber used by Behnken and Jaeger (5). Its inner radius is 125 mm.; its length, 405 mm. The axial electrodes are held by

thick. The diameter of the axial electrodes is 3.65 mm. The length of the guard electrodes is 106.2 mm.; the central measuring electrode is 41.08 mm. long. The distance between the measuring and the guard electrodes is (on both sides) 1.25 mm., so that the effective length of the measuring space is 42.33 mm. The distance from the axis of the electrodes to that of the chamber is 12 mm.

The chamber diaphragm is identical with that of Chamber I; its diameter is 7.85 mm., and its thickness 5 mm. The distance from the surface of the diaphragm to the center of the measuring volume is 301 mm.

The value of this volume is, therefore,

$$V = \frac{3.1416 \times 0.785^2}{4} \times \frac{120.1^2}{100^2} \times 4.233 =$$

$$V = 0.484 \text{ cm.}^2 \times 1.442 \times 4.233 \text{ cm.} =$$
$$V = 2.954 \text{ cm.}^3$$

Saturation is obtained for both chambers at a potential of 1,600 volts. Figure 7

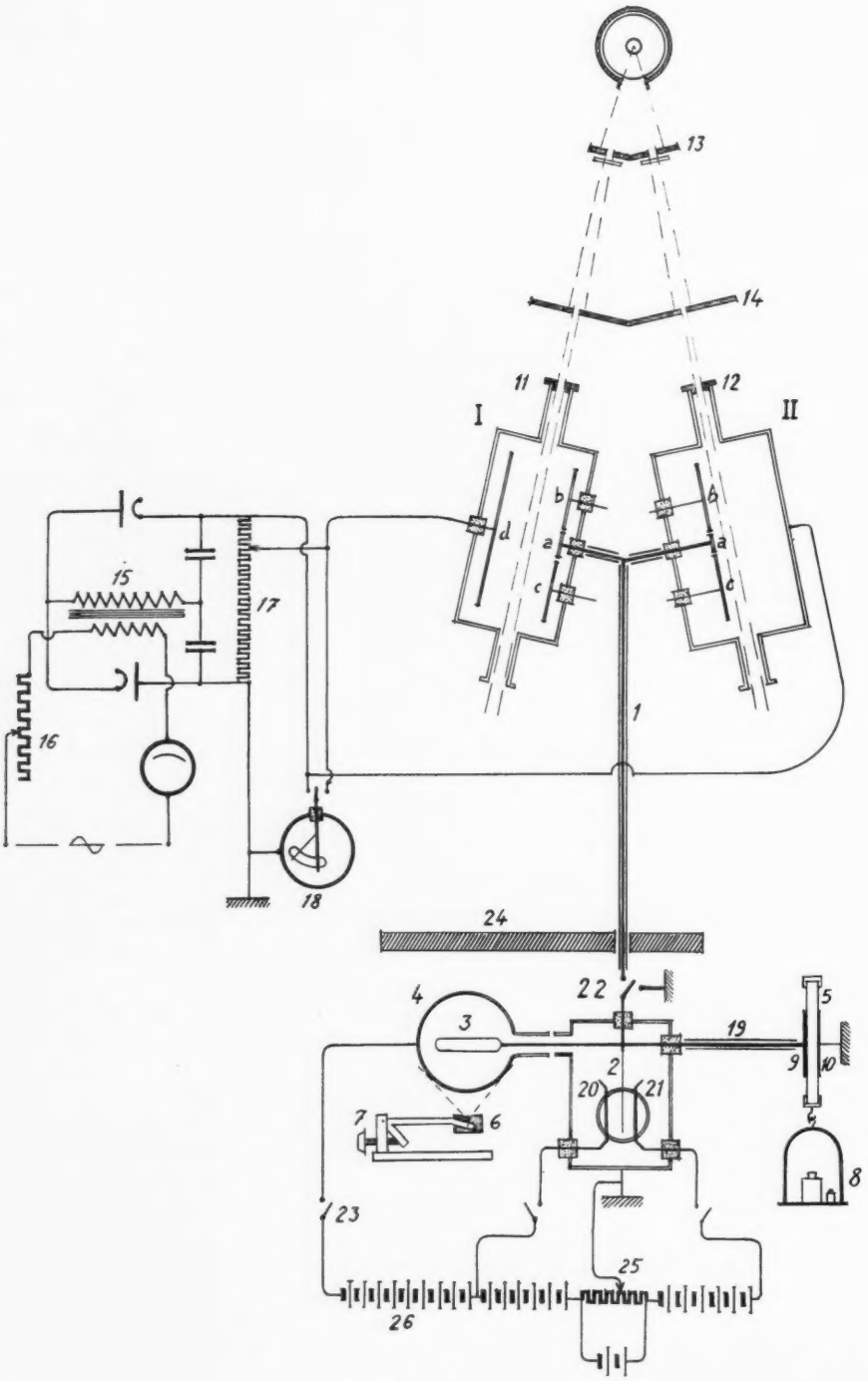
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Fig. 6.

shows the saturation curves for the two chambers.

We have not investigated the homogeneity of the electric field near the central electrode as this control has been satisfactorily carried out by some workers with chambers very similar to ours.

IV.—MEASURING ARRANGEMENTS

The chambers are so installed (Figs. 5 and 6) that their axes form an angle the plane of which is perpendicular to the axis of the tube, and are symmetrical to the axial plane perpendicular to the anode surface. In this way the location of both chambers is rigorously symmetrical, and the rays which reach them are equal in quantity and quality. The distance focus–diaphragm is, for both chambers, 1 meter as we have already said.

In the path of the rays, two diaphragms are interposed, having a thickness of 5 mm. lead: the first, *13*, at 15 cm. from the focus, has a diameter of 10 mm.; the other, having the same diameter, is situated at 80 cm. from the focus. The centering of both, and that of the chambers, is easy to make with a mirror placed on the back of the chambers. A fluoroscopic screen helps us to place each diaphragm in the center of the shadow of the preceding one. The rays, after passing through the chambers, do not find any object until they are absorbed by the walls of the room, covered with 3 mm. lead, at 4 meters from the focus.

For the measurements with thimble chambers, one of the standard chambers is removed, and the small chamber is placed at 120 cm. from the anode; the rays cover a circle of 30 mm., in which the small chamber is placed with the aid of a fluoroscopic screen. The chambers are mounted on supports of oak wood, furnished with porcelain feet. The diaphragms are fixed to a support in the form of the trunk of a pyramid, joined to the tube holder.

V.—CONSTANT VOLTAGE GENERATOR FOR THE CHAMBERS

We have employed a doubling rectifier system, *15*, following the Greinacher-Montage. The primary current is regulated by a resistance, *16*, in series with the primary of the transformer. In order to be

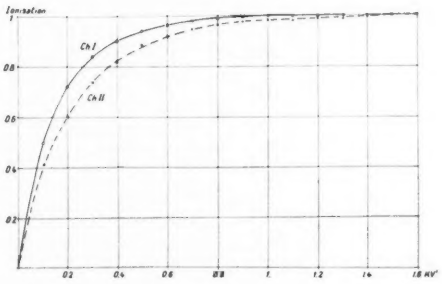

Fig. 7.

able to furnish a different voltage to each chamber we had mounted in the output of the condensers, a high ohmic potentiometer, *17*, having a value of 10 megohms. With the maximum voltage of 2,000 volts, it absorbs only a current of 0.2 milliampere; the fluctuations of the voltage due to the change and discharge of the condensers do not exceed ±5 per cent. Finally we have taken out this potentiometer, which gives a common voltage of 1,600 volts, a satisfactory saturation in both chambers.

For the measurement of the voltage we have employed an electroscope, *18*, similar to the gold leaf ones, but having as indicator a 0.1 mm. thickness aluminium ribbon mounted on a light pivot. The reading of the scale is made by projection. The scale has been calibrated with the aid of the storage batteries of the Piccard electrometer. As their voltage does not exceed 800 volts, we have proceeded in the following way: the part of the scale comprised between 0 and 800 volts has been directly checked against the battery units, with intervals of 100 volts, measured with a precision voltmeter. The rectifier has then been connected to the electrometer, and the primary rheostat, *16*, has been regulated in order to obtain an outlet voltage of 800 volts; then, the rectifier voltage remaining constant at this value, new battery groups of 100, 200, etc., volts have been connected

in series with the rectifier, and the voltage built up 900, 1,000, etc., until 1,600 volts have been marked on the scale. The same procedure is used anew for the part of the scale lying between 1,600 and 2,400 volts.

VI.—PIEZO-ELECTRIC QUARTZ

Figure 8 shows the arrangement of the piezo-electric quartz standard of quantity of electricity. The one employed by us has been measured in the Radium Institute of Paris. According to the certificate of the Institute, a quantity of electricity of 8.63 electrostatic units is set free in one of the plates, *9*, for each kilogram of weight suspended at *8* of the quartz, the other plate, *10*, being connected to the ground. The maximum margin of error of this determination is ±0.1 per cent.

The quartz is enclosed in a hermetically sealed box, with two glass windows. The passage of the main conductor, *19*, is made through a cylinder of pure amber. The air of the box is dried with a calcium chloride desiccator. The scale for the weights is suspended through a capsule full of consistent grease, by means of a Cardan transmission, in order to obtain a longitudinal traction in every case, even when the support is not balanced.

VII.—ELECTROMETER

The electrometer is the well-known model of Piccard (Fig. 9), in which the movable part is a Wollaston wire, *2*, of 8 microns diameter, symmetrically suspended freely between two electrodes, *20* and *21*, charged with equal voltages. The electric charges produced by ionization or by the piezo-electric quartz are transmitted to the string, whose deviation is proportional to them.

One of the spheres of the electrometer has been taken away, and replaced by the conductor, *19*, of the piezo-electric quartz.

Insulation has turned out satisfactorily. Many controls have been made. The string being insulated from the ground, and connected to the standard chambers by means of the interrupter, *22*, and the electrodes, *20* and *21*, being under tension but the rectifier, *15*, being stopped, the string remains still without losing its charge during a period of more than five minutes. If, under the same conditions, the x-ray apparatus is started, there is no leakage, a test which proves that no magnetic ionization or electric fields exist. If, then, the x-ray apparatus is stopped and Chambers I and II put under voltage, there appears a small spontaneous unavoidable leakage, of the same order of magnitude as that indicated by Thoraeus (*loc. cit.*).

Under these conditions, the chamber, *4*, is also connected to the battery by means of the switch, *23*. The leakage increases or diminishes, according to the amount of the applied voltage. Finally, the x-ray apparatus is started anew and, as the diaphragms of the standard chambers are covered with a piece of lead, the leakage does not increase.

Instead of making an analytic correction of the leakage, we have considered that it is more practical and simpler to compensate for it by producing an opposite current in the spherical chamber, *4*, the voltage of which is normally of the opposite sign to that of the standard chambers. For this purpose a needle of 1 mgr. of radium is placed near the sphere at such a distance that the string becomes permanently still.

The influence of the radium on Chambers I and II is eliminated by the screen, *24*, of 5 cm. of lead, the shadow of which covers most of the standard chambers. The electrometer itself possesses a system for eliminating the magnetic ionization produced in its own air.

Sensitivity and Symmetry.—Both are regulated by changing the distance from the electrodes, *20* and *21*, to the string, and the voltage applied to them. The symmetry is also produced by means of the potentiometer, *25*. It is satisfactory when the string remains at the same place, either connected to ground or insulated, and when deviations in opposite directions, but of the same value, are produced—the charge applied to the string remaining constant—on inverting the sign of the electrodes, *20* and *21*. A sensitivity of one centimeter of the

scale for one volt is already satisfactory for the measurements by the *nul* method. A greater sensitivity is then unnecessary, and then be increased up to two or three centimeters for one volt.

That the deviations of the string are

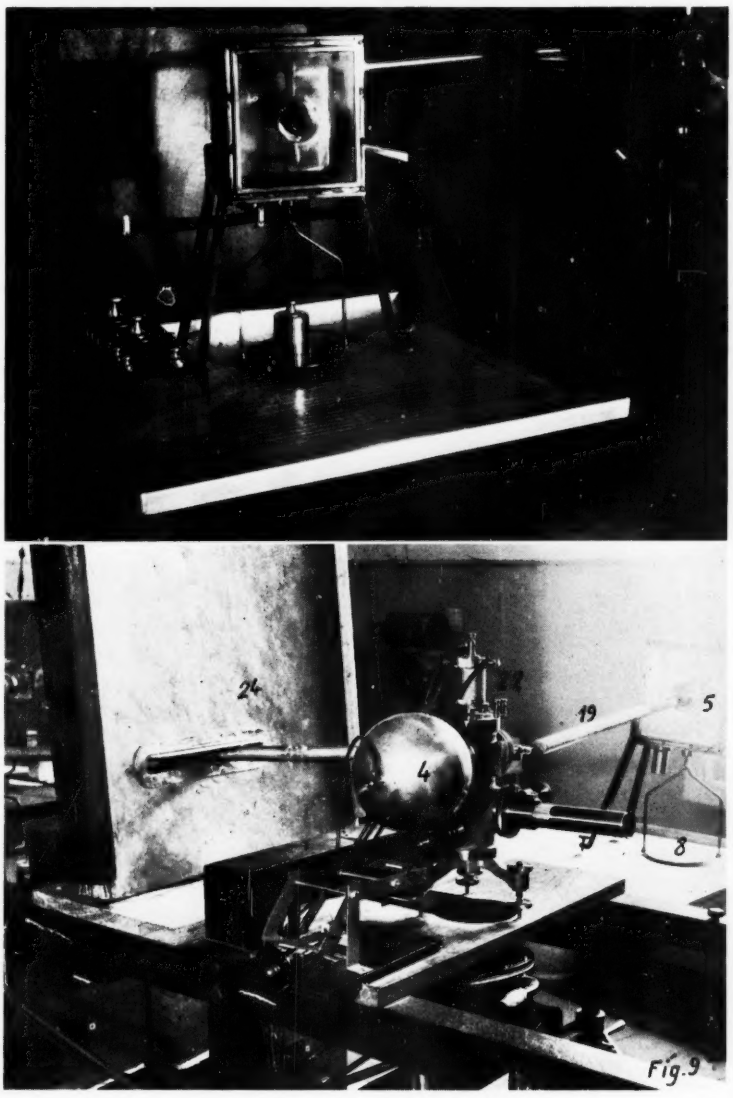

Fig. 8 (*upper*). Fig. 9 (*lower*).

diminishes the stability of the string. It is useful, therefore, for the calibration in absolute electrostatic units of the ionization current produced by the radium in the spheric chamber, *4*. The sensitivity can proportional to the electric charges applied to it is easy to check in changing the piezoelectric quartz with a complete series of weights, producing a proportional series of quantities of electricity.

VIII.—SECONDARY STANDARD OF INTENSITY

This is obtained on putting one or more tubes of radium at different distances from the spherical chamber, *4* (Fig. 2). As has been said, the intensity of that constant current is first arbitrarily varied, until its value manages to compensate for just the ionization current in Chamber I or II and to maintain the string quiescent. For this purpose, the radium is placed in the lead capsule, *6*. The distance from *6* to the sphere, *4*, is changed with the aid of the micrometric device, *7*.

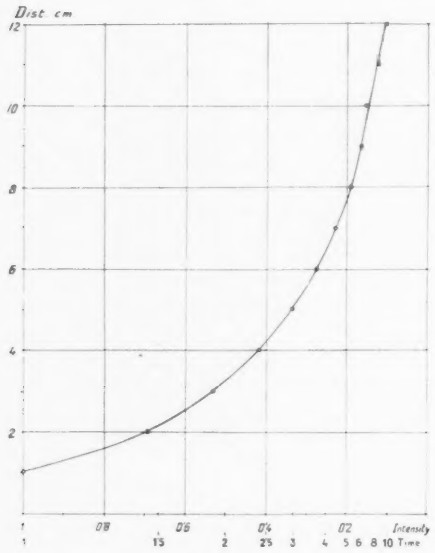

Fig. 10.

When the compensation is obtained, the x-ray apparatus is stopped, and the intensity of the current in the spherical chamber is measured with the aid of the piezo-electric quartz. As this measurement is repeated for each determination, it is not necessary to calculate the law giving the relationship between intensity and distance. This function varies according to the voltage of the battery, *26*, to the quantity of radium and to the capacity of the system. But the influence of the focus of radium is less important: with the same filtration and quantity of radium, the curve is nearly equal, be the focus one tube or two or three. In the first approximation the ionization varies in the same way as the solid angle, limited by the cone tangent to the spherical chamber and having its apex in the tube of radium.

Figure 10 shows the intensity *versus* distance law, with a tube of 10 mgr. of radium, taking as a unit the intensity, I, or the time of discharge, t, produced at 1 cm. from the tube to the sphere, and keeping the weight suspended to the piezo-electric quartz invariable for all distances.

Measurement of Intensities with the Piezo-electric Quartz.—This is measured in the following way: The compensation between standard chamber and radium chamber having been obtained, the x-ray apparatus is stopped and the switch, *23*, is opened. After having observed the position of the electrometer string, a weight is put on the scale of the quartz. The string is deviated and remains so; we observe then whether or not there exists a perceptible leakage, and compensate for it if necessary. In this case, the weight is removed, the string connected to the ground, and the operation is begun again. At last, the switch, *23*, is closed and the watch is started; it is stopped when the string passes its position of equilibrium previously determined. The intensity of the ionization current in the spheric chamber, and therefore in the standard one, is given in electrostatic units e.g.s., by the quotient:

$$\frac{\text{electric charge liberated by the quartz}}{\text{time of discharge}}$$

As the gamma-ray intensity is constant, and the deviations are proportional to the quantities of electricity, the velocity of the string is constant from the beginning of the discharge. The measuring is more exact if the chronometer is started when the string is already in motion, after having covered 4 or 5 mm. of the scale. In this case, the quantity of electricity must be multiplied by the quotient:

number of divisions covered by the string during the measurement / total number of divisions deviated by the action of the quartz

For example, if 8.63 electrostatic units have produced a deviation of 43 divisions, and the watch is started when the string passes through the point *36*, the intensity will be

$$I = 8.63 \times \frac{36}{43} \div t.$$

It would be possible to avoid the use of the radium secondary standard of intensity, and to measure directly by means of the piezo-electric quartz the current flowing in the standard chambers. We can proceed, then, in the following way: the x-ray tube being in function, we put on the scale of the quartz a weight arbitrarily chosen; the string is deviated. When the string passes again through the point zero, the watch is started and a new weight—the value of which is the only one that we take into account—is carefully put on the scale, so slowly that the string remains nearly still two or three divisions before the point zero. When the weight is totally released, we await the moment in which the string passes again through zero, and then we stop the watch. The intensity is, as before, given by the quotient quantity:time. However, the use of radium is the most convenient.

In every case, the intensity in roentgen units is given by the formula

$$I = \frac{Q}{t} \times 60 \times \frac{(1 + 0.00367\theta)\frac{760}{P}}{v_\theta},$$

in which: I = intensity in r/min.; Q = quantity of electricity set free by the piezo-electric quartz; t = time in seconds; P = atmospheric pressure in mm. Hg; θ = temperature in degrees C.; v_θ = measuring volume of air in the standard chamber at the temperature θ.

IX.—TIME, ATMOSPHERIC PRESSURE, TEMPERATURE, WEIGHT

The time has been measured with a precision stop-watch. The accuracy of the measurements depends chiefly on the time of reaction of the observer. With a good training, the mean error is of the order of ± 0 min. 4 sec. for each manipulation—starting or stopping—*i.e.*, a maximum error of ± 0 min. 8 sec. for each measurement. As the total duration of the measuring process is not less than 60 sec., the error in the time measuring is always under ± 1.3 per cent.

The pressure and the temperature have been measured with precision mercury instruments. The order of the error is about ± 0.2 per cent. The weights used with the piezo-electric quartz have been checked against those of the Spanish services of standards, and corrected in order to obtain the exact nominal values. The accuracy of their values is about 0.1 per cent.

X.—MEASUREMENTS

The measurements have been made with Chambers I and II, separated or mounted in parallel. Beside the normal diaphragm of 7.85 mm.ϕ, we have made control measurements with two others, having diameters of 4.05 mm.ϕ and 5.95 mm.ϕ, respectively. The voltages and filters have been chosen in order to have x-ray beams with nearly similar homogeneities and with such intensities that the time of measurements may be as long as possible, the intensities remaining, therefore, considerably superior to the leakages. Their values were comprised between 2.5 and 3 r/min. The weights suspended from the quartz had such a value that the time of discharge oscillated between 60 and 100 sec.

The combinations of tensions and filters have been the following:

(*A*) 60 kv., 4 ma., 1 mm. Al } tube "Multix."
(*B*) 100 kv., 4 ma., 5 mm. Al }

(*C*) 140 kv., 4 ma., 0.5 mm. Cu + 1 mm. Al } tube "Metwa Metalix."
(*D*) 180 kv., 4 ma., 1 mm. Cu + 1 mm. Al }

The following combinations of chambers and diaphragms have been used:

(*a*) Chamber I, diaphragm 4.05 mm. ϕ, air volume 1.068 cm.^{3}
(*b*) Chamber I, diaphragm 5.95 mm. ϕ, air volume 2.304 cm.^{3}
(*c*) Chamber I, diaphragm 7.85 mm. ϕ, air volume 4.01 cm.^{3}
(*d*) Chamber II, diaphragm 4.05 mm. ϕ, air volume 0.786 cm.^{3}
(*e*) Chamber II, diaphragm 5.95 mm. ϕ, air volume 1.686 cm.^{3}
(*f*) Chamber II, diaphragm 7.85 mm. ϕ, air volume 2.954 cm.^{3}
(*g*) Chamber I, diaphragm 7.85 mm. ϕ / Chamber II, diaphragm 7.85 mm. ϕ } air volume 6.968 cm.^{3}
(*h*) Chamber I, diaphragm 7.85 mm. ϕ / Chamber II, diaphragm 4.05 mm. ϕ } air volume 4.800 cm.^{3}
(*i*) Chamber I, diaphragm 4.05 mm. ϕ / Chamber II, diaphragm 7.85 mm. ϕ } air volume 4.022 cm.^{3}

The volumes indicated are those calculated from the geometric dimensions of the ionized space. All the measurements have been made at the temperature of 18° C., and at the atmospheric pressure of 767 mm. Hg; the necessary volume corrections have been made.

XI.—RESULTS OF THE MEASUREMENTS

The results of the measurements are indicated in Table I. According to these results, we have calculated the mean values and the mean errors for all the values obtained with the same chamber, voltage, and filter, and also for the whole of the measurements made for the same voltage and filter, with one or two chambers. We have employed the well known formulas: The mean intensity I_m, for a number n of measurements, has the value

$$I_m = \frac{\Sigma(I)}{n}.$$

The square mean error e of each measurement is given by

$$e = \pm\sqrt{\frac{\Sigma(\Delta^2)}{n-1}}$$

in which Δ is the difference between each value and the mean value I_m. The mean error E of the mean value I_m is

$$E = + \frac{e}{\sqrt{n}}.$$

Table II indicates the results of these calculations. The mean values obtained for each voltage and filter coincide satisfactorily for every group of measurements. The proportionality between the volume of ionized air and the intensity of ionization current is always maintained. The margin of fluctuation, determined by the mean error, is satisfactory, especially in the series *A* and *D*.

The comparison between the calculated error and that which can be conjectured, taking into account the margin of accuracy of each of the variables, leads also to a satisfactory concordance. The experimental errors can be classified in two groups:

(*a*) *Systematic Errors.*—These remain constant in every measurement, and, therefore, do not introduce differences between individual results. They arise chiefly from the geometrical factors: distance focus–diaphragm which is measured with a maximum margin of error of ±0.5 per cent; diameter of the diaphragm, ±1 per cent; length of the measuring electrode, ±0.5 per cent; piezo-electric quartz constant, ±0.1 per cent. That means a maximum difference of ±2.1 per cent between the real and the measured intensity, which cannot be eliminated, in a single series of determinations, by statistical methods.

(*b*) *Accidental Errors.*—These are inherent to factors changing from one measurement to another, and can be compensated for in a great number of determinations. They are: readings of the milliammeter,

TABLE I

			a	b	c	d	e	f	g	h	i
Chamber			I	I	I	II	II	II	I and II	I and II	I and II
Diaphragm (m./m. ϕ)			4.05	5.95	7.85	4.05	5.95	7.85	7.85 and 7.85	7.85 and 4.05	4.05 and 7.85
$V_{18°}$ (cm.^{3})			1.068	2.304	4.014	0.786	1.686	2.954	6.968	4.800	4.022
$V_{0.760}$ (cm.^{3})			1.00106	2.1802	3.798	0.744	1.595	2.795	6.593	4.542	3.806
Weight (kgr.)			0.4	0.8	2.0	0.3	0.6	1.0	3.0	2.0	2.0
Q (u.c.s.)			3.452	6.904	17.26	2.589	5.178	8.63	25.89	17.26	17.26
A	1	t. (sec.)	66.1 sec.	60.8 sec.	87.4 sec.	67.1 sec.	62.4 sec.	59.3 sec.	75.3 sec.	72.8 sec.	87.2 sec.
		J. (v.e.s./sec.)	0.05222	0.1136	0.1972	0.03860	0.0830	0.1455	0.3448	0.2370	0.1980
		I. (r/min.)	3.130	3.124	3.114−	3.115	3.122	3.124	3.128	3.130	3.123
	2	t. (sec.)	66.2 sec.	60.7 sec.	87.2 sec.	67.0 sec.	62.4 sec.	59.5 sec.	75.2 sec.	73.0 sec.	87.0 sec.
		J. (v.e.s./sec.)	0.05216	0.1138	0.1980	0.03865	0.0830	0.1450	0.3442	0.2367	0.1984
		I. (r/min.)	3.124	3.130	3.128	3.118	3.122	3.114	3.133	3.129	3.127
	3	t. (sec.)	66.2 sec.	60.9 sec.	87.4 sec.	66.8 sec.	62.4 sec.	69.3 sec.	75.5 sec.	72.7 sec.	86.8 sec.
		J. (v.e.s./sec.)	0.05216	0.1132	0.1972	0.03875	0.0830	0.1455	0.3430	0.2375	0.1988
		I. (r/min.)	3.124	3.118	3.114	3.127	3.122	3.124	3.120	3.136−	3.135
B	1	t. (sec.)	86.2 sec.	78.4 sec.	113.6 sec.	88.9 sec.	82.0 sec.	77.5 sec.	97.3 sec.	93.0 sec.	110.7 sec.
		J. (v.e.s./sec.)	0.04005	0.08802	0.1519	0.02913	0.06316	0.1113	0.1856	0.1856	0.1560
		I. (r/min.)	2.399−	2.420	2.400	2.348−	2.372	2.388	2.425	2.451	2.460
	2	t. (sec.)	86.3 sec.	78.5 sec.	113.4 sec.	88.0 sec.	81.4 sec.	77.4 sec.	97.8 sec.	93.5 sec.	110.1 sec.
		J. (v.e.s./sec.)	0.04000	0.08795	0.1523	0.02942	0.0636	0.1116	0.2648	0.1847	0.1568
		I. (r/min.)	2.412	2.419	2.404	2.372+	2.389+	2.396	2.410	2.440	2.471−
	3	t. (sec.)	86.2 sec.	78.2 sec.	113.6 sec.	88.5 sec.	81.8 sec.	77.2 sec.	97.0 sec.	94.3 sec.	111.0 sec.
		J. (v.e.s./sec.)	0.04005	0.08826	0.1519	0.02926	0.0633	0.1118	0.2669	0.1833	0.1555
		I. (r/min.)	2.399	2.430−	2.400	2.361	2.382	2.398−	2.429	2.421	2.450
C	1	t. (sec.)	82.4 sec.	74.5 sec.	108.5 sec.	84.8 sec.	78.4 sec.	74.1 sec.	92.6 sec.	88.3 sec.	107.4 sec.
		J. (v.e.s./sec.)	0.04180	0.0927	0.1591	0.03053	0.06603	0.1164	0.2796	0.1957	0.1607
		I. (r/min.)	2.502+	2.551−	2.513	2.461−	2.480	2.500−	2.545	2.584	2.532
	2	t. (sec.)	82.5 sec.	74.5 sec.	108.7 sec.	84.8 sec.	78.2 sec.	74.4 sec.	93.5 sec.	88.5 sec.	108.4 sec.
		J. (v.e.s./sec.)	0.04185	0.0927	0.1587	0.05053	0.06622	0.1160	0.2770	0.1950	0.1588
		I. (r/min.)	2.510	2.551	2.508	2.461	2.491	2.492	2.520+	2.575	2.503−
	3	t. (sec.)	82.1 sec.	75.0 sec.	109.1 sec.	84.8 sec.	78.5 sec.	74.3 sec.	90.8 sec.	88.0 sec.	106.5 sec.
		J. (v.e.s./sec.)	0.04198	0.0921	0.1582	0.03053	0.0659	0.1162	0.285	0.1961	0.1622
		I. (r/min.)	2.513	2.533	2.498+	2.461	2.475	2.496	2.594	2.590−	2.555
D	1	t. (sec.)	72.4 sec.	66.1 sec.	95.5 sec.	73.0 sec.	68.5 sec.	64.8 sec.	81.1 sec.	80.1 sec.	94.4 sec.
		J. (v.e.s./sec.)	0.0477	0.144	0.1808	0.03548	0.0755	0.1332	0.3152	0.2156	0.1828
		I. (r/min.)	2.860+	2.874−	2.857−	2.861	2.836−	2.858	2.869	2.849	2.880
	2	t. (sec.)	72.1 sec.	66.3 sec.	95.2 sec.	73.3 sec.	68.4 sec.	64.6 sec.	82.5 sec.	79.2 sec.	94.6 sec.
		J. (v.e.s./sec.)	0.0479	0.141	0.1812	0.3534	0.0757	0.1336	0.3137	0.2179	0.1824
		I. (r/min.)	2.872	2.868	2.862	2.850	2.842	2.865−	2.856	2.879	2.874
	3	t. (sec.)	72.2 sec.	66.2 sec.	95.2 sec.	73.2 sec.	68.4 sec.	64.7 sec.	81.6 sec.	79.5 sec.	94.1 sec.
		J. (v.e.s./sec.)	0.04782	0.142	0.1812	0.3536	0.0757	0.1334	0.3173	0.2170	0.1834
		I. (r/min.)	2.869	2.870	2.862	2.859	2.842	2.862	2.888−	2.868	2.888

±2 per cent; voltage, ±2 per cent; time, ±1.3 per cent; atmospheric pressure, temperature ±0.1 per cent for each factor; take into account the distortion of the electric field, in the cylindrical chambers, shown by Taylor (6) on comparing the

TABLE II

	Groups of Measurements	Im (r/min.)	e (r/min.)	e %	E (r/min.)	E (%)	Δ max. (r/min.)	Δ max. (%)
A	(*a*, *b*, *c*)	3.123	±0.00624$_5$	0.200	±0.00208	0.066	0.009	0.288
	(*d*, *e*, *f*)	3.121	±0.00446	0.139	±0.00149	0.0477	0.006	0.120
	(*g*, *h*, *i*)	3.129	±0.00529	0.169	±0.00176$_5$	0.0564	0.009	0.287
	(*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*)	3.124$_5$	±0.00643	0.205	±0.00124	0.0397	0.011$_5$	0.368
B	(*a*, *b*, *c*)	2.407	±0.0109$_5$	0.454	±0.00364	0.151	0.023	0.955
	(*d*, *e*, *f*)	2.378	±0.0166$_5$	0.700	±0.00555	0.233	0.030	1.26
	(*g*, *h*, *i*)	2.439$_5$	±0.0247	1.013	±0.0081	0.333	0.041$_5$	1.70
	(*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*)	2.408$_5$	±0.0299$_5$	1.244	±0.00576	0.239	0.062$_5$	2.59$_5$
C	(*a*, *b*, *c*)	2.520	±0.0210$_5$	0.835	±0.00671	0.266	0.031	1.23
	(*d*, *e*, *f*)	2.479	±0.0159$_5$	0.642	±0.00531	0.214	0.021	0.848
	(*g*, *h*, *i*)	2.555	±0.0327	1.283	±0.0107	0.428	0.052	2.07
	(*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*)	2.518$_5$	±0.0390	1.550	±0.00750	0.298	0.071$_5$	2.84
D	(*a*, *b*, *c*)	2.866	±0.00589	0.206	±0.00196$_5$	0.0687	0.009	0.314
	(*d*, *e*, *f*)	2.852	±0.00975	0.342	±0.00325	0.114	0.016	0.785
	(*g*, *h*, *i*)	2.872	±0.0134$_5$	0.469	±0.00447	0.156	0.023	0.800
	(*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*)	2.863$_5$	±0.0132	0.461	±0.00254	0.0887	0.027	0.945

weights, ±0.1 per cent; *i.e.*, a maximum margin of ±5.6 per cent between the extreme and the mean value. In fact, the maximum divergence we have observed has been 2.84 per cent.

It is interesting to point out that there exists, with all the voltages and filters, a small systematic difference between the measurements (*a*, *b*, *c*) made with Chamber I, and those (*d*, *e*, *f*) made with the barrel Chamber II, which are constantly a little smaller. This discordance is 0.064 per cent for the series *A*, 1.205 per cent for *B*, 1.627 per cent for *C*, and 0.488 per cent for *D;* its mean value is 0.846 per cent. Its origin is, perhaps, a not entirely compensated leakage. One reason for this is the fact that the measurements made with the two chambers together (*g*, *h*, *i*) do not give the mean values between those made separately with each chamber, in the same conditions (diaphragm, etc.) but intensities constantly greater. But, for the differences between the two chambers, we must cylindrical and the parallel plate models. We have already said why our chambers are relatively short, according to the requirement of Failla (7). Therefore, we think that our results will not be essentially modified by the small modifications we propose to make in our material, when circumstances allow us to compare it with other national standards.

BIBLIOGRAPHY

(1) Strahlentherapie, **50,** 364, 1934.

(2) Hase, H., and Küstner, H.: Ueber die Eichgenauigkeit von Eichstandgeräten im Dreielektrometerverfahren. Strahlentherapie, **29,** 730–744, 1928.

(3) Glasser, Otto, and Portmann, U. V.: The Standardization of Roentgen-ray Dose. Am. Jour. Roentgenol. and Rad. Ther., **19,** 47–61, January, 1928.

(4) Thoraeus, R.: A Study of the Ionization Method for Measuring the Intensity and Absorption of Roentgen Rays and of Efficiency of Different Filters Used in Therapy. Acta Radiol., Suppl. 15, 1–88, 1932.

(5) Behnken, H., and Wegner, R.: Die Deutsche Einheit der Roentgenstrahlendosis. Zeitsch. f. Technische Physik, **7,** 564, 1926.

(6) Taylor, L. S.: Precise Measurements of X-ray Dosage. Radiology, **14,** 372–384, April, 1930.

(7) Failla, G.: Criteria for the Design of a Standard Ionization Chamber. Am. Jour. Roentgenol. and Rad. Ther., **21,** 47–63, January, 1929.

CASE REPORTS

ROENTGEN THERAPY OF A PITUITARY TUMOR WITH REGENERATION OF THE SELLA, WITH GROWTH AFTER AGE EIGHTEEN

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Towne and others have reported a number of cases of pituitary tumor responding to external irradiation. Some have been rescued from blindness. It is generally believed that the acidophile is radiosensitive and the chromophobe type radioresistant. We are reporting a case of pituitary insufficiency in which the sella was restored to normal and the endocrine symptoms ameliorated after moderate roentgen therapy. Whether the thyroid and pituitary extract also given would have been sufficient without x-ray relief of the postulated pressure on the normal part of the gland, does not seem worth arguing.

CASE REPORT

A. P., male, was born in northern Italy on Nov. 14, 1912, of parents of normal size. At the age of 19, in August, 1931, he entered this hospital with the following complaints:

(1) Growing too slowly; (2) lacking hair on face, pubes, axillæ until age 18; (3) attacks of asthma and hives, and (4) failure to mature sexually (brought out on questioning), though he had been taking some gland preparation for a year.

General Physical Examination.—He has a general urticarial rash at the moment, in fact. He appears only 14 years of age. General physical, urine, blood, stool, electrocardiogram, glucose tolerance test were all negative. Blood pressure 100/80. Hair on scalp, brows, and lids normal, but scanty on face, pubes, and in axillæ. Testes normal, penis small. Fat deposits moderately accentuated on breast, symphysis, and hips; also the knees knock and show a moderate relaxation of ligaments and muscles; all feminine traits. (Figs. 3 and 4.)

Build Analysis.—All measurements stripped. His stature, 151.1 cm. (just under five feet), was 8 per cent below the Italian average; he may fairly be called a dwarf, since only 4 in 100 would be found so small. His weight, 47.5 k. (105 pounds), is 19 per cent too heavy for his height. Moreover, his bony frame is overly broad (Table I). Note the shoulders (masculine enough) and the wide bony pelvis (feminine). The sitting height shows him short-legged rather than eunuchoid.

TABLE I—BODY PROPORTIONS RELATIVE TO STATURE 100

	Patient	Normal Male of Similar Stature	Percentile
Sitting-height	52.9	51.4	9
Chest-girth	54.3	46.6	0.2
Chest-width	17.1	15.7	11
Chest-depth	11.6	11.1	27
Biacromial	23.3	21.1	0.2
Bicristal	18.1	15.8	0.1

The percentile 0.2 means that among 1,000 normals only two cases would be found whose measure was as far above the average as this.

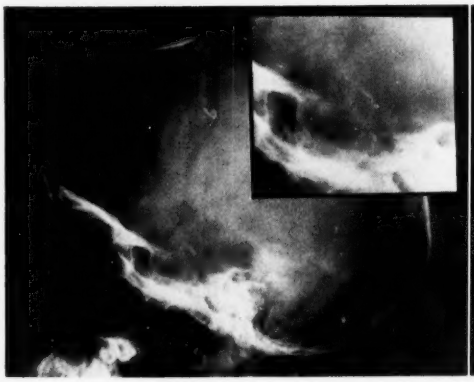

Fig. 1. Sellar shadow enlarged.

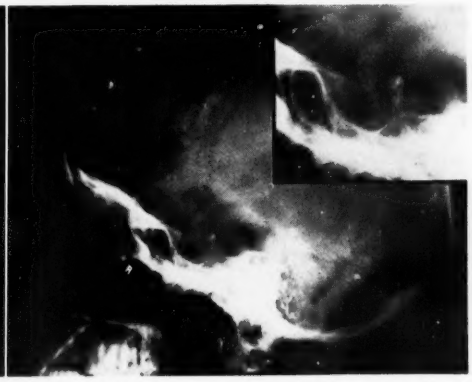

Fig. 2. Sellar shadow normal again.

His head is better considered in absolute measurements. The skull-box for age 19 was normal: length 200, breadth 151, and height (from top of earhole with Todd's spanner) 127 mm. His face was normal as to bizygomatic breadth 136 and nose-breadth 34 mm., but backwardness was detected in the face-length (nasion to tip of chin), which was only 113 *vs.* 123 mm., a deficit of 8 per cent which puts him at about the 10 percentile of males 19 years of age, and in the nose-height only 49 *vs.* 55 mm., a deficit of 11 per cent, putting him at about the 7 percentile.

Neuropsychiatric Examination.—No disturbance of eyesight; headache not more often than twice a year. Neurologic examination negative. I. Q. 85.

Ophthalmologic Examination.—Vision R. 15/20, L. 15/30. Fundi and fields normal. A suspicion of disturbance in color fields could

Fig. 3. Patient in 1931.

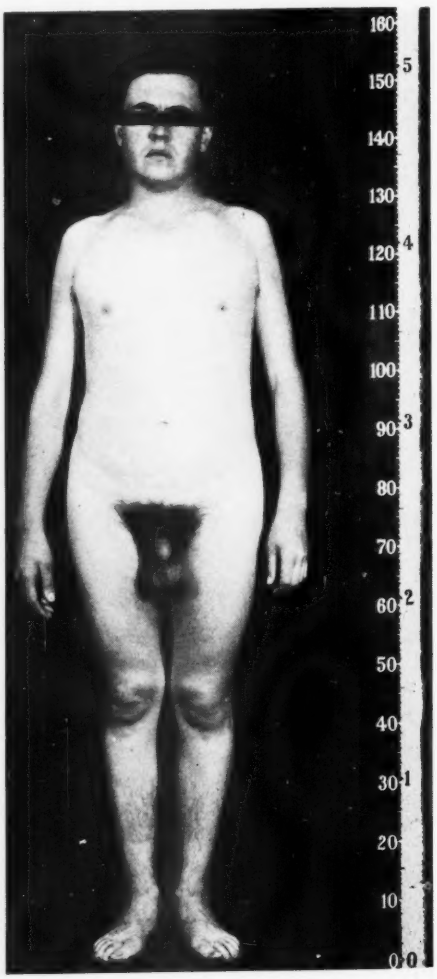

Fig. 4. Patient in 1938.

not be made certain even on repeating examination three times subsequently. Visual acuity later became normal (attributed to therapy).

Basal Metabolism.—Rate −25 per cent with pulse low, 60–64 (Aug. 8, 1931), and −14 per cent with pulse 60 (Dec. 1, 1931).

Bone-age.—At admission, Aug. 6, 1931, chronologic age 18.73 years, the radiologic age was only "between 14 and 16 years."

Roentgen Measurement of Sella.—At admission the inner cortex of the sella was decalcified to near invisibility. The outer cortex measured about 22.5 × 18 mm. The anterior clinoids appeared intact, but dorsum sellæ and posterior clinoids looked eroded. Now, seven years later, the sella has a normal appearance, dorsum and lining having regenerated, or at least recalcified. The external diameter has become less: about 20.5 × 13 mm., the floor being not nearly so depressed. The volume has shrunken to about two-thirds of what it was. It is now possible to measure the inside of the sella, about 10 mm. high and 14.5 mm. deep. If we take this as a segment of a sphere of 7.2 mm. radius, its volume is about 1.3 c.c. It is still a fairly big sella, about 15 per cent above upper normal limit, 50 per cent above average.

Diagnoses.—Pituitary tumor. Pre-adolescent hypopituitarism. Hypothyroidism, presumably secondary. Dwarfism. Sexual retardation. Allergy (urticaria and asthma).

Treatment and Progress.—The improvements in height, weight, and vision are demonstrated in Figure 5. The x-ray treatments, half value layer 0.8 mm. Cu, were given to forehead, vertex, and each temple, 8 × 8 cm. areas, 200 r to each of two areas each sitting, totalling 1,000 r to each, spread over five and one-half weeks Thyroid (Armour) grains ii daily was instituted and continued with some increases and decreases for three years. Relief of asthma occurred shortly after beginning thyroid, a phenomenon we have seen in another patient with asthma without suggestion of pituitary disease. However, the relief was not permanent. Anterior pituitary extract (antuitrin, Parke Davis) 1 c.c. was injected twice a week for four months as a first course, in 1932, and five months as a second course, in 1933. After three years, in 1934, pubic and axillary hair had become abundant, and skeletal development had come up to about 17, still four or five years delayed.

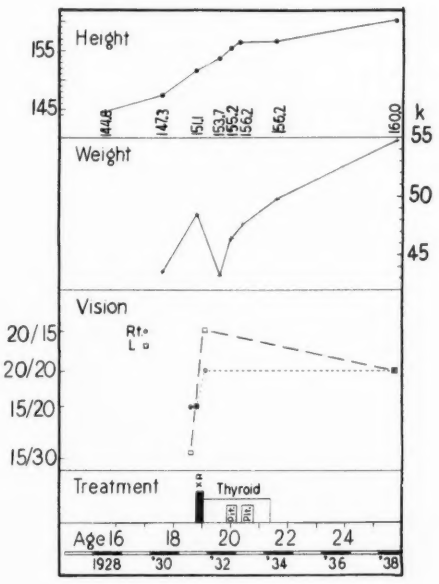

Fig. 5.

SUMMARY

A male, 18 years of age, with a pituitary tumor, hypopituitarism, hypothyroidism, dwarfism, sexual retardation, and allergy, showed by x-ray examination a definitely enlarged sellar shadow. Irradiation, together with thyroid and anterior pituitary extracts, were followed by improvements in height, weight, sexual maturation, and, temporarily, of the asthma. Particular attention is drawn to the extraordinary regression in the size of the sellar shadow.

COMPLETE TRANSPOSITION OF THE VISCERA IN SIBLINGS

By MAURICE FELDMAN, M.D., *and* NATHAN E. NEEDLE, M.D., *Baltimore, Maryland*

Complete transposition of the viscera is a congenital condition in which the position of all of the organs is reversed. Numerous instances of transposition, peculiar to only one member of a family, have been recorded. The total number is probably less than one thousand, but no doubt many more cases have been recognized but not reported.

In this communication an instance of complete transposition of the viscera in two members of one family is presented, with a brief review of the literature of its occurrence in siblings.

Single instances of transposition are not uncommon. The general incidence varies from 0.002 to 0.1 per cent, depending upon the source of material (1). It seems to be higher in autopsy studies. On the other hand, instances of two or more members in one family

affected with this anomaly are comparatively rare. The incidence of its occurrence in siblings with two or more members in the same family has not been established. Gall and Woolf (2), in 1934, could find only 19 instances of two or more cases in the same family, with only 15 occurrences in siblings—their case making 16. Since then we have been able to collect four more instances reported by Manson (3), Günther (4), W. M. Feldman (5), and Körner (6). Our case makes a total of 21 instances occurring in siblings recorded up to this time.

The etiology of transposition is based upon a developmental error. McMurrich has observed that in double monsters, one is the exact counterpart of the other, with the exception of a reversal of its organs. On this basis he is of the opinion that all cases of transposition were originally twins, formed from the division of a single embryo, one of which failed to develop. Boeminghaus (8) believes that in 50 per cent of twins, one will probably show a situs inversus. It is interesting to note that in Gall and Woolf's collected cases of two or more in one family, occurring in siblings, in only one instance were they twins. W. M. Feldman presents evidence regarding the transmissibility of visceral transposition as a Mendelian recessive character. He reported three patients in the same family, the parents of whom were first cousins. The parents' viscera were in normal position. According to Cahan, there is no record of thi anomaly being observed in parent and child. Doolittle (10), in 1907, however, reported a case in father and son.

Manson's two cases occurred in brother and sister. In Gall and Woolf's cases, both were sisters; Günther's were sisters; Körner's were two brothers, and W. M. Feldman's three cases were two sisters and one brother. Our two cases were sisters.

The 15 collected cases of two or more members in one family occurring in siblings recorded by Gall and Woolf were reported by Rogi (11), Carpenter (12), Doolittle (10), Reid (13), Lowenthal (14), Leroux, Labbé, and Barret (15), Reinhardt (16), Neuhof (17), Curschmann (18), Brimblecombe (19), Frölich (20), Hofmann (21), Liotta (22), Bianchi (23), and Ochsenius (24). Of these there were 13 instances with two members in the same family, and two instances with three members in the same family.

Case Reports.—Case 1. B. M. C., female, 12 years of age, of normal physical development, except for being underweight. She was delivered at home and her birth weight was normal. There was no evidence of any abnormality at birth. She has had the usual childhood communicable diseases. There are no symptoms evincing any abnormality of any of her organs. Her mentality is normal for her age. The physical examination is essentially negative except for a large nevus flammeus extending over the left side of face and neck, and a right-sided heart. The heart is normal except for its position. Roentgen examination revealed a total situs transversus of all the organs. Except for the transposition of the viscera, nothing abnormal was disclosed.

Case 2. R. A. C., female, 10 years of age, sister of the girl reported in Case 1, of normal physical development, except for being underweight. She was a normal birth and has had the usual childhood diseases. There is no history of symptoms referable to any of her organs. Physical examination revealed a right-sided heart. The roentgen examination showed a complete transposition of the viscera.

Both children were right-handed and showed no other abnormal congenital development. Their father and mother are living and well. Roentgen examination of the parents showed their organs to be in normal position.

CONCLUSIONS

An instance of two cases of complete transposition of the viscera occurring in siblings is presented, with a brief review of the literature. Single instances of situs inversus are not uncommon, but the occurrence of two or more members in the same family is comparatively rare.

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REFERENCES

(1) Feldman, Maurice: Clinical Roentgenology of the Digestive Tract, p. 774, William Wood & Co., Baltimore, 1938.

(2) Gall, E. A., and Woolf, V. F.: Situs Inversus Viscerum Totalis in Siblings. Ann. Int. Med., **7,** 1370–1375, May, 1934.

(3) Manson, J. S.: Two Cases of Transposition of the Viscera in One Family. British Med. Jour., **1,** 1171, June 8, 1935.

(4) Günther, H.: Die biologische Bedeutung der Inversionen. Biol. Zentralbl., **43,** 175–213, 1923.

(5) Feldman, W. M.: Transposition of Viscera Behaving as a Mendelian Recessive Character with Congenital Absence of the Appendix. Proc. Royal Soc. Med. (Clinical Sect.), **28,** 753–756, April, 1935.

(6) Körner: Situs inversus totalis bei zwei Brüdern. Röntgenpraxis, **9,** 197, 198, March, 1937.

(7) McMurrich, J. P.: The Development of the Human Body, seventh edition, p. 49. P. Blakiston's Son & Co., Philadelphia, 1923.

(8) Boeminghaus, H.: Ueber Dickdarmanomalie bei Situs Transversus. Deutsche Ztschr. f. Chir., **155,** 174, 1920.

(9) Cahan, J. M.: Transposition of All Viscera. Med. Jour and Rec., **122,** 75, 1925.

(10) Doolittle, W. F.: Congenital Dextracardia. Boston Med. and Surg. Jour., **157,** 662, 1907.

(11) Rogi, E.: Storia di una transposizione dei visceri. Sperimentale, **14,** 376, 1880.

(12) Carpenter, G.: Congenital Morbus Cordis:

Complete Transposition: Transposition of Liver, Spleen, and Large Intestine: Cyst in Tongue: Solitary Kidney. Proc. Royal Soc. Med., second section (Stud. Dis. Child.), **223,** 1908–1909.

(13) REID, D. McK.: Transposition of the Viscera Occurring in Brothers. Lancet, **1,** 717, 1909.

(14) LOWENTHAL, L.: Transposition of the Viscera Occurring in Brothers. Lancet, **1,** 461, 1909.

(15) LEROUX, C., LABBÉ, R., and BARRET, G.: Inversion viscerale totale chez deux frères de 13 et 7 ans. Bull. Soc. Pediat. de Paris, **14,** 297, 1912.

(16) REINHARDT: Ein Fall von Situs viscerum inversus totalis bei Zwillingen (Rekruren). Deutsche mil. ärztl. Ztschr., **41,** 931, 1912.

(17) NEUHOF, S.: A Case of Congenital Familial Dextracardia. Jour. Am. Med. Assn., **60,** 1064, 1913.

(18) CURSCHMANN, H.: Fämiliärer Situs Viscerum Inversus Totalis. Anatomische Hefte. 1[57]; 171/73 Heft, p. 405, 1919.

(19) BRIMBLECOMBE, S. L: Transposition of Viscera in Two Members of One Family. British Med. Jour., **2,** 889, 1920.

(20) FRÖLICH, T.: Forhandlinger i. medicinsk. Selskab, 1920.

(21) HOFMANN, A. H.: Familial Situs Inversus. Zentralbl. f. Chir., **53,** 1633, 1926.

(22) LIOTTA, D.: Situs viscerum inversus complicato a stenosi dell' arteria polmonare e communicazione interventricolare. Riforma med., **43,** 869, 1927.

(23) BIANCHI, S.: Case Report. Riv. med., **35,** 189, 1927. Cited by Gall, E. A., and Woolf, V. F. Ann. Int. Med., **7,** 1370, 1935.

(24) OCHSENIUS, K.: Ueber familiaren Situs inversus. Monatschr. f. Kinderh., **19,** 27, 1920–1921.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

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EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

RADIATION THERAPY

The branch of medical science now known as radiology has been built up by the amalgamation of the knowledge and skill of two diverse arts—physiology and physics. The physiologist, for his researches, has had to look to the physicist for the necessary tools and implements. The physicist supplying those tools has had to look to the research results of the physiologist to guide him in the improvement and further development of those tools.

Consequently, such a journal as RADIOLOGY, which ably records the most recent advances in radiological technic and research, is of inestimable value as a guide to the physicist desirous of contributing to those advances by supplying continually better tools.

Radiation therapy, as it is practised to-day, and even more in its potentialities for future development, is of such enormous moment to suffering humanity that no effort should be spared to increase its effectiveness. But, at times, the exploration of untried extensions involves such large expenditures of time, energy, and money that an effort should be made to limit the scouting parties to a number adequate but not extravagantly large. For, in the end, it is the public which must pay.

A good illustration is the development of x-ray generators of a million volts or more for experimental therapy. The development has been costly, but is justified as long as the possibility exists that better results may be obtained with voltages higher than with those in common use. Moreover, actual experiment by a number of distinct groups of medical men is needed in order to determine with certainty the value of those results.

But, to the physicist, this does not mean that the number of those groups should be needlessly multiplied, nor that the high voltage potentialities should be explored through a needless series of relatively small voltage gradations.

The medical profession is more competent than the physicist to decide how many groups of workers are needed, in order that authoritative conclusions may be drawn from their combined results. But, on the second point, the physicist is surely entitled to his opinion. He knows the nature of radiant energy, and from his knowledge it is permissible for him to conclude that no greatly different effects are likely to be produced by voltages not greatly differing.

For instance, an increase from 100,000 to 200,000 volts meant an upward step of one octave, which the physicist might reasonably hope would be rewarded by the discovery of new or better results. The next step from 200,000 to 400,000 was another octave, and from 400,000 to 1,000,000 was an octave plus. Each increase represented a sufficient change in the character of the radiant energy to cause the physicist to await most eagerly the physiological results obtained by its use.

But in view of the great cost of each upward step, always at the expense of the public, the physicist can now take little interest in so minor an advance beyond a million as a hundred thousand or two. If experimental results seem to have justified the expense of the million-volt development, the physicist would wish to see the next goal set at not less than two million, *i.e.*, another octave, to be followed, if, and only if, results shall have justified the last step, by the long stride of another octave, to at least four million volts.

Just so far as the results of radiological research point toward higher voltages as desirable, just so far will the physicist enthusiastically bend his energies toward the desired goal.

WILLIAM D. COOLIDGE, *Director*

Research Laboratory
General Electric Company
Schenectady, New York

BERNARD H. NICHOLS, M.D.: AN APPRECIATION

Bernard H. Nichols, promptly called "Nick" by even casual acquaintances, was not born with a silver spoon in his mouth. Instead, he set out to furnish himself with physical and intellectual sustenance—and has succeeded. He battled his way through Starling Medical College, graduating in 1904. As soon as the growth of the Van Dyke, which he still sports, had become sufficiently luxuriant, he associated himself in the practice of medicine with W. W. White, M.D., who had established a small hospital at Ravenna, Ohio. It became necessary to examine patients roentgenologically, so Nick undertook the study. This interest and his inherent mechanical ingenuity made him inquisitive about orthopedics, so in 1912 he began taking courses of instruction in this speciality under E. W. Ryersen, M.D., at Polyclinic Hospital, Chicago. This work continued with interruptions, but was completed in 1916, just in time for Nick to enter Military Service in the World War.

He was commissioned First Lieutenant and because of previous experience was ordered to the Military School of Roentgenology, New York He became a special instructor in bone pathology under Major Frederick H. Baetjer until ordered overseas as roentgenologist for Base Hospital No. 55, located at Toul, France. He found time for research on roentgenologic measurements of the heart which earned him a citation for Distinguished Service from General Pershing and promotion to the rank of Captain. After returning to the United States, he served as roentgenologist at Embarkation Hospital, No. 4, New York, and was honorably discharged from the Service in August, 1920. Immediately thereafter he entered the practice of roentgenology in association with the surgeons F. E. Bunts, M.D., George W. Crile, M.D., and W. E. Lower, M.D., who later founded the Cleveland Clinic, in 1921, and he has continued as roentgenologist at this institution.

Nick has been actively interested in radiological societies, having served on many committees and having held offices in all of the national organizations. He is a charter member and has been President of the Cleveland Radiological Society. Elected to membership in the American Roentgen Ray Society in 1920, he was Vice-president in 1936. Joining the American College of Radiology in 1926, he has been one of the Chancellors for the past four years. He has served as special examiner for the American Board of Radiology. Becoming a member of the Radiological Society of North America in 1920, only five years after its organization, he has been a member of its Counsel, of the Executive Committee, Vice-president, and now is President. Of course he belongs to many non-radiological medical societies.

Nick's numerous publications and lectures on many subjects relating to diagnostic roentgenology always have been received as emanating from an authority. He has made only one attempt to publish a book and that was in collaboration with W. E. Lower, M.D., on "Roentgenological Studies of the Urinary Tract" (not adv.). He has designed apparatus, the original combined roentgenographic-cystoscopic table, a head rest, and other types of equipment.

Although Nick's principal interest has been in the practice of medicine and roentgenology in particular, he has found time for many other activities. He commutes from his home in Ravenna to Cleveland, and is one of his home town's leading citizens. He has been repeatedly elected to its Board of Education. He claims to be a Democrat, possibly because he likes the name rather than the party's policies. He was one of the organizers of the Community Hospital, served as consultant on its staff, and has been instrumental in raising and maintaining its high standards. Also, he is a leader in the professional societies of the community and delights to lecture to the laity on medical subjects.

As a personality, Nick is unique. He has a vast sense of humor, spontaneous wit, and philosophical tolerance for human frailities which give him a particular aptitude to make and to keep friends. Other characteristics typify the man: his love for flowers, which he cultivates in his beautiful garden; his patience and faithfulness in the performance of any task that he undertakes. The Radiological Society of North America will profit by his leadership.

U. V. PORTMANN, M.D.

BERNARD H. NICHOLS, M.D.
President of the Radiological Society of North America

ANNOUNCEMENTS

MID-WINTER CONFERENCE OF EASTERN RADIOLOGISTS

The thirtieth annual Mid-winter Conference of Eastern Radiologists will be held in Boston, on Friday and Saturday, Jan. 26 and 27, 1940, with headquarters at the Hotel Statler.

The New England Roentgen Ray Society cordially invites all radiologists of the Eastern Seaboard to attend. The program will consist of contributions by members of the Boston City, Peter Bent Brigham, Beth Israel, and Massachusetts General Hospitals. The first all-day session will be held at the Hotel Statler, with luncheon and the annual banquet held at the same place. The Saturday morning session will take place at the Massachusetts General Hospital, and that afternoon members are invited to visit the Massachusetts Institute of Technology.

MID-WESTERN RADIOLOGISTS' FOURTH ANNUAL CLINICAL CONFERENCE

LOUISVILLE, KY., FEB. 9 AND 10, 1940

The Fourth Annual Clinical Conference of the Mid-western Radiologists will be held at the Brown Hotel, Louisville, Ky., on Feb. 9 and 10, 1940. In the program emphasis is placed on the clinical aspects of problems of interest to radiologists. Most of the presentations are to be given by men active in the practice of clinical medicine. The Kentucky Radiological Society is host to the Conference.

Further information may be obtained by addressing J. C. Bell, M.D., General Chairman, 402 Heyburn Bldg., Louisville, Ky.

INTERNATIONAL COLLEGE OF SURGEONS

The United States Chapter of the International College of Surgeons will hold its Fourth Annual Assembly, Feb. 11–14, 1940, in Venice, Florida. In addition to prominent American speakers, professors of surgery from Brazil, Canada, Cuba, Mexico, and Turkey will lecture. Scientific and technical exhibits will be displayed in the patio of the Florida Medical Center. A well-rounded social program has been planned for the visiting surgeons, their wives, and guests.

For any information, including the presentation of scientific papers or exhibits, please address Charles H. Arnold, M.D., Secretary to the Scientific Assembly, Terminal Building, Lincoln, Nebraska.

COMMUNICATIONS

REPORT OF THE TWENTY-FIFTH ANNUAL MEETING

The silver anniversary meeting of the Radiological Society of North America was held at the Atlanta-Biltmore Hotel, in Atlanta, Georgia, Dec. 11–15, inclusive. The meeting was under the able leadership of President Raymond G. Taylor, who had arranged an excellent program of high scientific interest.

The annual Carman Lecture was delivered by Dr. Francis Carter Wood, of New York City, his subject being "The Biological Effects of Radiation." He gave an excellent discussion of the subject from all angles. At the conclusion of his address, Dr. Wood was presented with the Gold Medal of the Society.

The Refresher Courses, which were originated at last year's meeting, were again a popular and well attended part of the scientific program. There were twenty-six courses presented this year, *viz.*: (1) A Review of Some Cases of Bone Tumors, John T. Murphy, M.D., and Plinn F. Morse, M.D.; (2) Diseases of the Small Intestine, Ross Golden, M.D.; (3) Radiology of the Gastro-intestinal Tract and Gall Bladder, B. R. Kirklin, M.D.; (4) Radiology of the Colon, E. L. Jenkinson, M.D.; (5) Radiology of Sinuses and Mastoids, George W. Grier, M.D.; (6) Film-reading session, W. Edward Chamberlain, M.D., and L. Henry Garland, M.D.; (7) The Anatomy, Physiology, and Mechanics of the Chest as the Basis for Study of Chest Diseases and Their Classification, W. Walter Wasson, M.D.; (8) Cardioradiology, Samuel Brown, M.D.; (9) Roentgen Diagnosis of Silicosis, W. M. Doughty, M.D.; (10) The Basic Principles of Protracted Fractionated External Irradiation, Milton Friedman, M.D.; (11) Film-reading session, M. C. Sosman, M.D., and Ross Golden, M.D.; (12) X-ray Therapy in the Treatment of Carcinoma of the Skin, J. M. Martin, M.D.; (13) Radiation Therapy of the Lymphoblastomas, B. P. Widmann, M.D.; (14) The Treatment of Cancer of the Breast, U. V. Portmann, M.D.; (15) The Treatment of Carcinoma of the Cervix, Edwin C. Ernst, M.D.; (16) Roentgen

Analysis of Fractures, W. Edward Chamberlain, M.D.; (17) Roentgen Kymography, Wendell G. Scott, M.D.; (18) Radiology of the Genito-urinary Tract, B. H. Nichols, M.D.; (19) The Roentgenologic Aspects of the Arthritides, L. H. Garland, M.D.; (20) Radiologic Investigation of the Spine and Sacroiliac Joints, Fred J. Hodges, M.D.; (21) Radiology of the Skull, M. C. Sosman, M.D.; (22) Encephalography and Ventriculography, Karl Kornblum, M.D.; (23) Myelography, John D. Camp, M.D.; (24) Diseases of Bones of Children, Leo G. Rigler, M.D.; (25) Physics of Radiation (Elementary Course), Edith H. Quimby, M.A., J. L. Weatherwax, M.A., and Otto Glasser, Ph.D.; (26) Physics of Radiation (Advanced Course), Edith H. Quimby, M.A., Otto Glasser, Ph.D., and Merle Tuve.

The scientific exhibits again constituted one of the highlights of the meeting. There were 23 of these exhibits, arranged in a manner designed to provide a maximum amount of instruction. The Committee on Scientific Awards recommended the following: First Award to Robert S. Stone, M.D., and J. Maurice Robinson, M.D., for an exhibit entitled "Skin Reactions and Depth Doses: A Comparison of 1,000 kv. and 200 kv. Radiations." Second Award to W. Edward Chamberlain, M.D., for an exhibit entitled "Basilar Impression (Platybasia)." Honorable Mention was given to Ross Golden, M.D., for an exhibit entitled "Roentgen Examination of the Small Intestine with the Miller-Abbott Tube."

On Wednesday evening the members and guests were entertained at the Druid Hills Country Club as the guests of the commercial exhibitors and the Georgia Radiological Society. The evening's fun consisted of a typical Southern barbecue, and reached an all-time high in entertainment.

The following men were elected to serve as officers during 1940: *President*, B. H. Nichols, M.D., Cleveland; *President-elect*, W. Walter Wasson, M.D., Denver; *First Vice-president*, Robert R. Newell, M.D., San Francisco; *Second Vice-president*, Rabun T. Wilson, M.D., Austin, Texas; *Third Vice-president*, Leo G. Rigler, M.D., Minneapolis; *Secretary-Treasurer*, Donald S. Childs, M.D., Syracuse, N. Y.; *Librarian*, Charles G. Sutherland, M.D., Rochester, Minn.; *new member of the Executive Committee*, A. L. L. Bell, M.D., Brooklyn, N. Y.

MINNESOTA RADIOLOGICAL SOCIETY

The Fall Meeting of the Minnesota Radiological Society was held in Rochester on Dec. 2, 1939.

The program was as follows:

1. Experiences with Roentgenologic Pelvimetry, by C. A. Good, M.D., and A. B. Hunt, M.D.
2. The Proctosigmoiditis of Lymphogranuloma Venereum, by H. M. Weber, M.D.
3. Pseudo-fractures in Diseases Affecting the Skeletal System, by J. A. L. McCullough, M.D. Discussion, J. D. Camp, M.D.
4. The Evaluation of Prostigmine, Barium Chloride, Oxygen and Pitressin for the Elimination of Flatus, in Roentgenograms of the Abdomen, by E. E. Seedorf, M.D.
5. Symposium: Primary Carcinoma of the Lung:
   - X-ray Diagnosis, by J. W. Olds, M.D.
   - X-ray Treatment, by E. H. Little, M.D.
   - Discussion, opened by E. T. Leddy, M.D.
6. Intrathoracic Tumors, by S. W. Harrington, M.D.

IN MEMORIAM

WILLIAM W. LARSON, M.D.

Word was received only on Nov. 16, 1939, of the death on Jan. 20, 1939, of William W. Larson, M.D., who died at his home in Le Mars, Iowa. He was born in Decorah, Iowa, on Jan. 5, 1884. He attended Luther College, and later received his degree in medicine from the State University of Iowa. He took post-graduate work at Harvard Medical School.

Dr. Larson held memberships in his county and state organizations; the American Medical Association; the Radiological Society of North America, and was a Diplomate of the American Board of Radiology. He was on the Staff of Sacred Heart Hospital of Le Mars, and was Secretary-Treasurer of the Iowa X-ray Club at the time of his death.

WILLIAM L. ROSS, M.D.

Dr. William L. Ross, a veteran physician, surgeon, and radiologist, died at the Nicholas Senn Hospital, in Omaha, Nebraska, on Aug. 26, 1939, aged 80 years. He had practised in Omaha since 1891, where he was well known for his pioneer accomplishments in the roent-

gen-ray therapy of mastoiditis and appendicitis, and as the author of a number of papers on allied subjects.

Dr. Ross graduated from Rush Medical College, Chicago, in 1883 and from Bellevue Hospital Medical College, New York City, four years later. He did post-graduate work in London. He was a member of the Douglas County Medical Society, Nebraska State Medical Association, American Medical Association, Nebraska Radiological Society, the Radiological Society of North America, both the International and American Congresses of Radiology, and the American Congress of Physical Therapy. He was Professor of Dental Neurology at Creighton Dental College from 1905 to 1922.

During the course of his long life, Dr. Ross made many friends who will regret his loss.

AMÉDÉE GRANGER, M.D.

Dr. Amédée Granger, internationally famous medical expert in the field of radiology and chief of the radiological department at Charity Hospital, New Orleans, La., for the past thirty-four years, died of a heart attack on Dec. 15, 1939.

Dr. Granger, director of the radiological department at the Louisiana State University medical center, was born in New Orleans sixty years ago. He graduated from the old Boys' High School and from Tulane University. He was honored by the governments of France, Belgium, and Italy, being made a Knight of the Crown by the kings of Belgium and Italy and receiving the silver and gold academic palms from the government of France. The Radiological Society of North America awarded him the Society's gold medal in 1926 in recognition of his achievements.

While an undergraduate in the School of Medicine at Tulane University, Dr. Granger was mustered into service for the war with Spain in 1898, and served in the hospital corps. He returned to Tulane and received his degree in 1901. In 1916 he was appointed professor of radiology in the graduate school of Tulane. He left Tulane University before the graduate school merged with the school of medicine two years ago and joined the Louisiana State University medical center faculty.

Dr. Granger was appointed in 1905 to organize the radiology department of the Charity Hospital. He was alloted 169 square feet of space and one orderly, but even with that meager equipment he made many x-ray examinations. Through his efforts this department is now one of the largest in the country; as well equipped with modern x-ray apparatus as any.

The late Amédée Granger, M.D.

The contribution to science of which Dr. Granger was most proud was the development of x-ray treatment for acute mastoiditis in children, before the softening and breaking down of bone. In 1930, when he first read a paper on this new form of therapy, the board of administrators of Charity Hospital tendered a reception in his honor, the first time a member of the staff had received such a reception.

In 1929 King Albert of Belgium, through the Belgian consul in New Orleans, made him a Knight of the Order of the Crown. King Victor Emanuel of Italy paid him the same honor in 1930, and in 1934 the Legion of Honor of France, which country had already honored him twice, received him into membership.

Dr. Granger held membership in many medical and scientific societies. He was a

charter member and a past chancellor of the College of Radiology; past president of the Orleans Parish Medical Society; honorary member of the Texas Radiological Society; honorary member of the New Orleans Ophthalmological Oto-laryngological Society; honorary member of the Alpha Omega Alpha medical fraternity; past first vice-president of the Radiological Society of North America; past president of the Louisiana State Society of Radiology; collaborator of the journal RADIOLOGY, and past vice-president of the Association of French-speaking Physicians of North America.

On Aug. 15, 1917, Dr. Granger was married to Miss Corinne Pruitt, who survives him. Two sons by a former marriage, Amédée, Jr., and Carrol, also survive.

Dr. Granger's hobby was devising gadgets for improving the field of roentgenology and affording certain information of great value. His localizer and sinus and mastoid boards are well known and are in constant use. By means of his sinus board the Granger line is clearly visualized, from which line he could diagnose diseases of the sphenoid sinus. His laboratory was literally filled with ingenious devices for his own convenience.

Dr. Granger was truly a gentleman of the old school; cultured, scholarly, and refined. The medical profession of New Orleans and this country will miss his genial personality and his progressive interest in the field of radiology.

LEON J. MENVILLE, M.D.

BOOKS RECEIVED

Books received are acknowledged under this heading, and such notice may be regarded as an acknowledgment of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ATLAS DES RÖNTGENREIHENBILDES DES BRUSTRAUMES (Atlas of Serial Roentgenograms of the Thorax): On the Basis of an Evaluation of More than 900,000 Serial Screen Views. Collected by Dr. HANS HOLFELDER and Dr. FRIEDRICH BERNER. A volume of 95 pages, with 244 illustrations. Published by Georg Thieme, Leipzig, 1939. Price: 19.60 R.M. bound (25 per cent discount allowed to foreign purchasers).

INTRODUCTION TO RADIOLOGY. By FRED JENNER HODGES, B.S., M.D., Professor of Roentgenology, School of Medicine, University of Michigan, Roentgenologist to the University Hospital, Ann Arbor, Michigan, and WILLIS SEAMANS PECK, B.S., M.D., Assistant Professor of Roentgenology, School of Medicine, University of Michigan, Radiation Therapist to the University Hospital, Ann Arbor, Michigan. A volume of 262 pages, with numerous illustrations. Published by Edwards Brothers, Inc., Ann Arbor, Mich., 1939. Price: $4.00.

PROCTOSCOPIC EXAMINATION AND DIAGNOSIS AND TREATMENT OF DIARRHEAS. By M. H. STREICHER, M.S., M.D., University of Illinois, College of Medicine, Research and Educational Hospital and Grant Hospital of Chicago. A volume of 149 pages, with 39 illustrations. Published by Charles C. Thomas, Springfield, Ill., 1939. Price: $3.00.

DIFFERENTIALDIAGNOSTIK DER LUNGENERKRANKUNGEN IM RÖNTGENBILDE (Roentgenographic Differential Diagnosis of Diseases of the Lungs), with Especial Consideration of the Lateral Position. By Dr. O. SIMON, head of the Roentgenologic Division of the Medical Clinic, University of Koenigsberg. A volume of 84 pages, with 204 illustrations. Published by Georg Thieme, Leipzig, 1939. Price: 19.00 R.M. (25 per cent discount allowed to foreign purchasers).

TUMORS OF THE SKIN, BENIGN AND MALIGNANT. By JOSEPH JORDAN ELLER, M.D., Attending Dermatologist, City Hospital, New York City; Consulting Dermatologist: French Hospital and Broad Street Hospital, New York City; Unity Hospital, Brooklyn; Morristown Memorial Hospital, Monmouth Memorial Hospital, Fitkin Memorial Hospital, Norwalk General Hospital, etc. A volume of 607 pages, illustrated with 403 engravings. Published by Lea & Febiger, Philadelphia, 1939. Price: $10.00

THE 1939 YEAR BOOK OF RADIOLOGY. Diagnosis edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital. Therapeutics edited by IRA I. KAPLAN, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, City of New York; Clinical Professor of Surgery, New York University Medical College; Director, Radiation Therapy Department, Bellevue Hospital, New York City; Associate Radiologist, Lenox Hill Hospital, New York City. A volume of 528 pages, with 509 figures. Published by The Year Book Publishers, Inc., Chicago, 1939. Price: $4.50.

BOOK REVIEWS

CANCER HANDBOOK OF THE TUMOR CLINIC (Stanford University School of Medicine). Edited by ERIC LILJENCRANTZ, M.D. A volume of 114 pages, with 50 illustrations. Published by Stanford University Press, Stanford, California, 1939. Price: $3.00.

This book, designed not for radiologic specialists but for the general practitioner, aims to acquaint him with the methods for adequate handling of patients through the stages of suspicion, diagnosis, consultation, and treatment. The chapters on tumors of the mouth, breast, and uterus particularly fulfill this ideal, and the book is especially to be commended for its urgence of microscopic examination of questionable lesions.

PHYSIOTHERAPY IN MEDICAL PRACTICE. By HUGH MORRIS, M.D., D.M.R.E., Honorary Consulting Radiologist, Devonshire Royal Hospital, Buxton; Honorary Radiologist, Salford Royal Hospital, Royal Manchester Children's Hospital, Manchester Victoria Memorial Jewish Hospital, etc.; Radiologist, Manchester Corporation Hospital Services; Examiner in Electrotherapy to the Chartered Society of Massage; Lecturer in Electrotherapy, Schools of Massage, Salford Royal and Devonshire Royal Hospitals, etc. A volume of 276 pages, with 102 illustrations. Published by Williams & Wilkins Company, Baltimore, 1939. Price: $4.50.

This book contains twenty-two chapters, the first thirteen dealing with electrotherapy, the next five with ultra-violet radiation, one chapter with infra-red radiation, and two chapters dealing with indications for the employment of electricity and light in medicine.

The title is misleading, since many important phases of physical therapy are not discussed at all. The important fields of hydrotherapy, massage, corrective exercise, and fever therapy are not included in this text. It is simply a dissertation on electrotherapy and light therapy.

The material which is presented is concise and clear; however, many types of apparatus which are more or less obsolete have been described. An example is the water rheostat. The so-called "universal apparatus" is well described; however, this device, although still used on the Continent, is practically never employed in the United States. Also, some of the newer apparatus employed on the Continent have been described only briefly. The so-called "wall plate" has been carefully described, although, because of the danger of electrocution of the patient, this device has been officially forbidden in many European countries.

The author's terminology is in some respects antiquated; for example, he still speaks of a connecting cord as a "rheophor." The Handbook on Physical Therapy of the American Medical Association describes this term as "obsolete."

By far the best section in the book is that portion of the appendix which deals with precautions against shock from electromedical apparatus. There is a well prepared glossary at the end of the book which serves its purpose well.

In summary, it might be said that this book, if considered as a British textbook on electrotherapy and light therapy with special consideration of the older methods of treatment, is very interesting. It cannot be considered in any sense a complete text on the subject of physical therapy. For the general practitioner in this country it would seem to be of theoretical rather than practical interest.

A TOPOGRAPHIC ATLAS FOR X-RAY THERAPY. By IRA I. KAPLAN, M.D., and SIDNEY RUBENFELD, M.D., A volume of 119 pages, with 55 full-page plates. Published by The Year Book Publishers, Chicago, 1939. Price: $4.00.

In this atlas the authors present a series of schematic drawings showing projections of the skeleton and inner organs on the body surface. For many conditions the customary fields used in roentgen therapy are indicated, thus correlating landmarks discernible on the skin with topographic anatomy. When using the atlas allowance must be made for individual variations and, whenever possible, controls are advisable based on actual roentgenograms taken of the particular patient.

Many radiologists will undoubtedly object to the following statements in the introduction: "And naturally, a thorough understanding of the patient's anatomy adds to the keenness of the *technician* and the efficiency of the irradiation. . . . Not only by description but also by actual visualization translated to the surface of the body should the *technician* know the organs and their location in order to direct the irradiation so as to obtain the most effective reaction on the pathologic area and avoid harming the intervening normal tissues and structures." Your reviewer feels that the adjustment of the portals is a strictly medical task and should not be delegated to a technician.

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ANIMAL EXPERIMENTATION

The Effect of Roentgen Rays on the Galliera Sarcoma *in vivo* and *in vitro*. G. Toniolo. Strahlentherapie, **65,** 375, 1939.

The author studied the effect of roentgen rays on the Galliera sarcoma in rats. He used radiation produced at 120 kv. (no filter), 140 kv. (3 mm. Al), and 165 kv. (0.5 mm. Cu + 3 mm. Al) and doses varying from 280 to 3,500 r. A comparison of the effect of x-rays on the mashed tumor tissue *in vitro* with the growth *in vivo* showed that the same dose destroys both, provided that the neoplasms were of recent origin. From the fifteenth day on after the implantation, the radioresistance of this sarcoma increases and after the thirtieth day the doses used in the experiments described had no effect. If filtration and potential were increased, smaller doses were required for the sterilization of the growth. Disappearance of the neoplasm after irradiation or injection of sterilized mashed tumor tissue does not produce immunity in the rats and new implants with the same neoplasm will take again.

ERNST A. POHLE, M.D., Ph.D.

The Factor "Lambda" in Radiobiology. M. Lapenna. Strahlentherapie, **65,** 247, 1939.

The author undertook a series of experiments regarding the influence of the wave length on the biological effect. X-rays produced at 110 kv., filtered through 1 mm. Al, and at 160 kv., filtered through 0.5 mm. Cu + 1 mm. Al, 38 r/min. for both with the same dose of 570 r were used; 600 mg. radium element at 1 cm. distance, filtered through 1 mm. Pt, delivering 2.6 r/min. and a dose of 540 r constituted the source of gamma radiation. Lapenna studied the cholesterol content in blood and parenchymatous organs of rats, the salt and water content of skin and organs, the calcium and phosphorus content of bone, changes in the blood count, effect on the growth of young rats and also seedlings of beans (*Vicia faba equina*). Although the experiments have not been completed, the preliminary results indicate that the most intense biologic changes were produced with hard roentgen rays (160 kv.) while the effect was less for roentgen rays of longer wave length (110 kv.) and also for gamma rays of radium. An interpretation of the observations is attempted.

ERNST A. POHLE, M.D., Ph.D.

Effect of Roentgen Rays on Bone Marrow *in vivo* and *in vitro*. A. Gregori. Strahlentherapie, **65,** 163, 1939.

The author exposed the bone-marrow cultures of guinea pigs and also the thighs of living animals to roentgen rays. The cultures received doses up to 30,000 r (180 kv., 15 ma., 18 cm. distance; 906 r/min.). The thighs of the guinea pigs were exposed with the same technic except that 20 cm. F.S.D. and a filter of 0.5 mm. Cu were used and the doses varied from 250 to 10,000 r. The effect of roentgen rays on the cultures was noted after doses around 10,000 r. Giant cells appeared about two days after exposure to doses of from 10,000 to 20,000 r. A total of 30,000 r destroyed the cultures. In the experiments *in vivo*, 2,000 r retarded the regeneration and caused necrobiotic reactions. Bone marrow used for culture four days after the administration of 6,000 r appeared to be completely destroyed and showed marked fatty degeneration. Very interesting were experiments in which massive doses of x-rays were given to the spleen of the guinea pigs producing changes in the bone marrow by "reflex" effect. The regenerative power of the bone-marrow elements which were used for a culture was definitely reduced. This effect was less noticeable if the bone marrow in the thigh was treated directly.

Photomicrograms are appended to illustrate some of the histologic findings.

ERNST A. POHLE, M.D., Ph.D.

Is There an Effect of X-rays on Skeletal Muscles if the Doses Applied do not Exceed the Skin Tolerance? H. Bade. Strahlentherapie, **65,** 455, 1939.

The author exposed the skeletal muscles in dogs with doses of x-rays which produced permanent epilation. Histologic examination of the irradiated muscle tissue from four days to two months after the exposure did not show any definite morphologic changes. Additional experiments were carried out in rats using 2,000 r without filter at 180 and 60 kv. Although this produced an ulceration of the skin which eventually healed, neither the connective tissue nor the muscles showed definite changes during observation periods of from four days to four weeks after the irradiation. The infraspinatus muscle of a patient who had received a total dose of 3,000 r in fractional doses could be studied microscopically four weeks after the last treatment; there were also no histologic changes detectable. Determinations of the excretion of creatine and creatinine and also in the blood of 11 patients undergoing irradiation showed no deviations from the normal and consequently allowed the conclusion that no degenerative processes were taking place in the muscles. The author believes, therefore, that in outlining a plan of irradiation no injuries of the muscles are to be expected provided the skin tolerance is not exceeded.

ERNST A. POHLE, M.D., Ph.D.

APPARATUS

Rapid Roentgenography in the Operating Room, with a Single Solution. F. R. Wilkinson. Jour. Bone and Joint Surg., **11,** 387–392, April, 1939.

The author has modified the solutions suggested by R. G. W. Ollerenshaw, of England. This preparation consists of (*A*) hydroquinone, 8 gm.; (*B*) elon or metol, 8 gm.; (*C*) sodium sulphite, 100 gm., sodium carbonate, 60 gm., and sodium hydroxide (stick), 50 gm. with water to 1,000 c.c.; (*D*) sodium thiosulphate, 375 gm. and water to 1,000 c.c.

Portions (*A*) and (*B*) are dissolved separately in 100 c.c. of hot water, then mixed. To this is added 400 c.c. of solution (*C*) and 400 c.c. of solution (*D*). This solution should be mixed just before use as it deteriorates overnight. The chemicals must be analytically

pure. The exposure to x-rays should be doubled in time. The developing time required is 45 seconds. The films show no bone detail and should later be fixed in "hypo" for three minutes and washed in water for permanent record.

J. B. McAneny, M.D.

The Lost Drain and its Roentgen-ray Identification. H. S. Crossen and Wendell G. Scott. Jour. Missouri Med. Assn., **36**, 202–210, May, 1939.

Occasionally drains placed in abdominal incisions or in the vagina are missing when the time comes to remove them. The question then arises as to whether the drain came loose and was accidently discarded with the dressings or whether it slipped into the body cavity. The value of roentgen-ray visibility of drainage-tube material is obvious in such cases. The authors conducted a series of experiments to determine what type of rubber tube gave the best visibility. Using a model pelvis with a paraffin phantom, they found that red rubber tubes cast very good shadows when placed in the mid-pelvis. Black and amber tubings were not satisfactory from the standpoint of roentgen-ray visibility. Even the small sizes of red tubing, the common red Dakin tube, were easily visible on the roentgenograph. For cigarette drains and Penrose drains, the only material giving satisfactory shadows was a specially made, thin red rubber sheeting.

L. W. Paul, M.D.

Measurements during "Pendulum" Irradiation. M. Bender and A. Köhler. Strahlentherapie, **65**, 468, 1939.

The authors report their experience with an x-ray therapy tube which is so constructed that it swings over the patient like a pendulum during the exposure. They undertook a series of measurements in a paraffin phantom by means of a condenser dosimeter. The results obtained are shown in three graphs. It appears that doses on the surface in the direction of the pendulum swing are different if the irradiated body is not of circular outline. In the direction true to the swing, the maximum dose was not found in the pendulum center but was shifted, the amount of shift depending on the width of the exposed area. There is a definite dependence of the distribution of the dose from the angle of rotation.

Ernst A. Pohle, M.D., Ph.D.

Roentgen-ray Fluorescence and Biology. M. Lenzi. Strahlentherapie, **65**, 158, 1939.

The author describes briefly a new apparatus which is suitable for the study of roentgen-ray fluorescence and phosphorescence. A diagram illustrating the construction and working principles is shown in the article.

Ernst A. Pohle, M.D., Ph.D.

A Simple Method for Stereoscopic Measurements. Helge Christensen. Acta Radiol., **20**, 137–146, April, 1939.

This new method of stereoscopic measurement is based on two exposures: one from a known and fixed focus–film distance and the other from the double distance. If the distance to be determined is approximately parallel with the plane of the film, it can be calculated after a simple method developed by the author. Calculations by means of a ruler are necessary if the unknown distance forms an angle with the plane of the film.

Ernst A. Schmidt, M.D.

A One-million Volt Generator for Producing Radioactive Substances. E. P. Vanoni. Strahlentherapie, **65**, 304, 1939.

The author describes in a well illustrated paper the construction of a 1,000,000-volt generator which delivers 2 ma. and 950 kv. and has been installed at the Physics Institute of the University of Padua (Italy). The circuit uses five valve tubes and condensers; the vacuum of the multisectional tube is maintained by oil diffusion pumps.

Ernst A. Pohle, M.D., Ph.D.

ARTHRITIS

The X-ray Treatment of Humero-scapular Periarthritis. S. Mustakallio. Acta Radiol., **20**, 22–32, February, 1939.

The author describes his experience in the x-ray treatment of 200 cases of humero-scapular periarthritis. Of this total, 113 cases could later be traced and used for statistical purposes. The cases observed are divided into acute, chronic, and traumatic periarthritis, and arthritis of the acromio-clavicular joint. In acute cases, two doses of 150 r each were, as a rule, sufficient; in the other cases larger doses were necessary.

While in acute periarthritis about 40 per cent were cured within the first week of treatment, the results were considerably less favorable in the other groups. If all groups were considered, the percentage of cases cured after six months amounted to 63 per cent. Including those improved, the percentage even in the chronic group was as high as 94 per cent.

Ernst A. Schmidt, M.D.

BACKACHE

Painful Spinal Osteoporosis. Pierre P. Ravault, Jacques Graber-Duvernay, and Gustave Léger. Jour. de méd. de Lyon, **20**, 69–85, Feb. 5, 1939.

In a paper too long and detailed for adequate condensation, the authors discuss the etiology, diagnosis, and treatment of osteoporosis of the vertebræ. These cases occupy a relatively important place in the syndromes of thoraco-lumbar pain. Their differentiation from other syndromes is essential, although at times difficult. Treatment is directed at favoring fixation of calcium in the skeleton and sedation of the painful phenomena. Preparations of calcium orally and parenterally are valuable. Adrenalin, adrenal cortex, and thyroid extract have been employed with varying success. Preparations of vitamin D are often beneficial as are heliotherapy and ultra-violet therapy. Dia-

thermy, histamine intradermally, sulphoidol, and orthopedic support are recommended as procedures designed to relieve the pain. X-ray therapy was not successful in the one case in which it was tried.

S. R. BEATTY, M.D.

BILIARY TRACT

Experimental Researches on the Radiological Anatomy of the Extrahepatic Biliary Ducts. Pier Luigi Cova and Giambattista Tempini. La Radiol. Med., **26,** 226–258, March, 1939.

The authors made an extensive postmortem study of the extrahepatic biliary ducts in 44 cases which, during life, presented no symptoms referable to the biliary tract. Care was taken not to cause alterations of the ducts when injecting the contrast medium. Iodized oil or barium sulphate, suspended in a creamy medium, was used for this purpose. In most instances it was possible to obtain excellent visualization of the duct and its principal ramifications, and to demonstrate that there are numerous variations in the morphology of these ducts, especially in that portion designated as the ampulla of Vater. This showed many shapes, the morphology changing from subject to subject. It was found, however, that the papilla was present in about 70 per cent of the cases studied.

ANTONIO MAYORAL, M.D.

The Roentgen Diagnosis of the Biliary Passages. K. A. Zwicker. München. med. Wchnschr., **86,** 532–542, April 7, 1939.

The author reviews the anatomy and physiology of the biliary tract, and discusses the roentgen examination. Fluoroscopy of the gall bladder without contrast medium is of extremely limited use, but a plain film of this region is valuable. The use of oral and intravenously administered opaques is discussed, but transduodenal methods and rectal methods of administration are deliberately omitted. The suggestion that, if both the gall bladder and stomach are to be studied, they be filled simultaneously to show the relation between the gall bladder and duodenum, seems valuable. There follows a description of the form, appearance, and position of the normal gall bladder, a discussion of emptying and its time relations, diminished function as shown by poor concentration of dye, non-function, and various cholecystopathies. The suggestion that in rare cases non-visualization may be due to pressure from extrinsic tumors or foreign bodies is interesting. It is also pointed out that, while cholecystography is contra-indicated in severe liver damage or in icterus gravis, simple jaundice, as in catarrhal jaundice, is not a contra-indication, and visualization may occur.

This review is rather detailed, and excellent for a beginner in radiology or for practitioners in other fields who wish a somewhat precise knowledge of this procedure. The text is illustrated with some good reproductions. Most radiologists will find it somewhat elementary although not unprofitable, even for them.

LEWIS G. JACOBS, M.D.

BONE DISEASES (DIAGNOSIS)

Tuberculosis of the Symphysis Pubis. Louis Alpert. New England Jour. Med., **220,** 786–792, May 11, 1939.

The author comments upon the few reports of tuberculosis of the symphysis pubis to be found in the literature, especially in the English literature. The condition may well be more common than the reports would suggest.

Four cases are reported in this article, more from their clinical aspect than the roentgenologic. The symptoms are an irregular gait, a tumor mass, and pain in the region of the pubis. Backache may be a complaint and the tumor may be in the groin and be mistaken for a hernia.

X-ray examination shows an irregular destruction of the pubic bones which may extend along the rami. In the four case histories here completely presented, inactive tuberculous infection in the lungs was found; one patient had had a tuberculous kidney removed; another had a tuberculous prostate.

The diagnosis depends upon the demonstration of tubercle bacilli.

J. B. MCANENY, M.D.

Osteomyelitis of the Sphenoid Bone: Report of Five Cases with the Autopsy Findings. Howard C. Ballenger. Ann. Otol., Rhinol., and Laryngol., **48,** 95–102, March, 1939.

Osteomyelitis of the sphenoid bone is not common. Teed, in 1938, after a careful search, found 139 cases of meningitis secondary to infection of the sphenoid sinus. He also found that this sinus was involved in about 15 per cent of the clinical cases of sinusitis and in about 33 per cent of pathologic cases, but was responsible for about 35 per cent of all intracranial complications of nasal origin. Extension of infection from the sphenoid mucosa to the bony structure or meninges occurs in most instances by a suppurative thrombophlebitis of the small vessels.

The diagnosis of osteomyelitis of the sphenoid bone before the onset of intracranial complications is difficult. The symptoms of sphenoiditis would be present in most cases. There may be deep-seated headache behind the eyes or radiating to the temporal or occipital regions. Eye symptoms such as photophobia, lacrimation, scotomas, or blepharospasm may be noticed. Postnasal discharge is usually present. As invasion of the bone occurs, symptoms and signs of sepsis may ensue These usually are mild until intracranial extension develops.

Roentgenologic examination is of considerable value. It may show a cloudy or vague outline of the sinus wall. This increased density may extend into the middle fossa or along the base of the skull. The sella turcica may show changes associated with an osteitis or osteomyelitis.

The most frequent complication is a meningitis, next a thrombosis of the cavernous sinus. The author reports five cases which came to autopsy. In four, a Type

III pneumococcus was recovered and in one a hemolytic streptococcus. Extension to the meninges occurred in two, and to the cavernous sinus in one.

LESTER W. PAUL, M.D.

BREAST

Technic of Post-operative Radiation Therapy in Carcinoma of the Breast. F. Perussia. Strahlentherapie, **65,** 74, 1939.

Post-operative irradiation of the breast should be carried out as soon as possible after the surgical intervention; that is, as soon as the general condition and the appearance of the wound will permit. The author uses the following technic: 160 kv., 0.5 mm. Cu + 1 mm. Al, H.V.L.$_{Cu}$ 0.8 mm., 60 cm. F.S.D., from 5 to 6 r/min., 150 r over a large field including half of the chest wall, the axillary area, the supra- and infraclavicular regions; total dose in approximately 20 days, 2,500 r. This simple technic is preferred because it does not require as much time as the multiple field technic in which accurate adjustment of all ports is imperative, and also because experience has shown that damage to pleura. heart, and lungs is not to be feared.

ERNST A. POHLE, M.D., Ph.D.

X-ray Treatment of Carcinoma of the Breast. Lyell C. Kinney. California and West. Med., **50,** 333–336, May, 1939.

This is a very interesting discussion concerning x-ray treatment in cancer of the breast. Quoting from the opening paragraph and from the summary will illustrate the value of this paper. The discussion which follows the article is also of great interest.

"Between the enthusiastic claims of some radiologists and the iconoclastic statements of some surgeons there are certain proven facts concerning the value of x-ray in carcinoma of the breast that can now be accepted. Any critical estimate must be based on a careful analysis of what constitutes early curable cancer and what must be considered late cancer, where only palliation can be expected. It is certain that x-ray cannot replace surgery in early operable cancer of the breast, and it is equally certain that radical surgery cannot replace x-ray or improve the palliation in late advanced cancer. The important problem is how far, if at all, surgery and radiation should overlap in the treatment of carcinoma of the breast."

The summary reads as follows:

"1. The prognosis of carcinoma of the breast depends primarily on early recognition and complete radical surgery.

"2. Early carcinoma clinically localized to the breast should have immediate biopsy by excision and radical surgery. If metastatic glands are found in the axilla or if the growth is undifferentiated of pathological Groups 3 or 4, the surgery should be followed by post-operative radiation.

"3. Early cancer, with clinically enlarged axillary glands, should have pre-operative radiation before radical surgery, followed by post-operative radiation. If this is not possible, the surgery should be followed by post-operative radiation, as there is evidence that radiation will add 10 to 15 per cent to the expectancy of cure from surgery.

"4. The value of x-ray in combination with radical surgery in Group 2 cases does not justify operating on cases that are not strictly localized, or expecting the radiation to add to the curability following questionable surgery.

"5. Pre- and post-operative radiation are never an excuse for incomplete surgery in operable cases. Post-operative x-ray following incomplete surgery will not increase the probable cure.

"6. Carcinoma of the breast, which is not clinically localized to the gland and movable axillary lymphatics, must be considered late and inoperable. Only palliation is possible, and that is best obtained by radiation."

JAMES J. CLARK, M.D.

CANCER (DIAGNOSIS)

Early Diagnosis of Cancer of the Gastro-intestinal Tract and the Gruskin Malignancy Test. Souren Tashian. Northwest Med., **38,** 214–218, June, 1939.

The author refreshes our knowledge that cancer is curable if diagnosed early, and again dwells on the well-known difficulty of such early diagnosis in the gastro-intestinal tract.

He presents a new diagnostic test which indicates the presence of malignancy before the appearance of any clinical signs and symptoms.

The writer claims no part in the scientific development of the test but has followed its workings and usefulness and heartily endorses it. He states that Schwartz and Oliver reported 93 cases of cancer in which this test of Gruskin was correct in 91. Bacon reported 277 cases from the departments of the University Hospital, Temple Medical School, with 100 per cent correct diagnoses. Pratt, of Columbia University, reported 92 per cent correct results with the Gruskin test.

The test is intradermal, apparently simple, and, as shown above, highly valuable. To roentgenologists, who encounter the great majority of cases of gastro-intestinal diseases for diagnosis, and who are so familiar with the difficulties met with in arriving at a differential diagnosis, the use of Gruskin's test should be a welcome addition to the diagnostic equipment and its use should be encouraged for a proper evaluation.

A. MAYORAL, M.D.

Radiologic Treatment of Skeletal Metastases in Mammary Carcinoma. Helge B. Wulff. Acta Radiol., **20,** 40–67, February, 1939.

In 45.5 per cent of the radiologically treated cases with bone metastases following cancer of the breast, good, occasionally even striking, improvement was observed. The improvement was manifested both subjectively in a diminution of the patients' symptoms and objectively in a delimination of the changes in the roentgenograms. In three cases even a roentgenologic healing with prac-

tically complete regression of all bone lesions could be demonstrated. Radiation of bone metastases as early as possible is advocated. The observation that transitional stages from osteoclastic lesions to osteosclerosis can occur in the same patient influenced by x-ray treatment and healing processes, proves that all these different manifestations of skeletal metastases are only changing phases of the same pathologic-anatomic entity and cannot be considered independent tumor types.

ERNST A. SCHMIDT, M.D.

CANCER (THERAPY)

Low Voltage Roentgen Therapy in Skin Cancer. William S. MacComb. Am. Jour. Roentgenol. and Rad. Ther., **41,** 437–440, March, 1939.

Of all the methods of therapy of skin cancer, low voltage radiation appears to be the best because no cosmetic disturbance is produced, and, if the lesion is near the eye, the problem of shielding is much more easily controlled than with the use of radium. This method does not apply to the more infiltrating lesions.

Employing 100 kv., 5 ma., no filter, and 30 cm. distance to 10 fields on the anterior and lateral thigh, 12 patients were treated. This produced 270 r per minute. The half value layer of this radiation was 0.03 mm. Cu or 1 mm. Al. The fields measured 0.5 cm., 1 cm., 2 cm., 3 cm., and 4.5 cm.

The "threshold erythema" was used as the biologic unit and was the amount that would produce, in 80 per cent of patients treated, a visible pigmentation in one month when given at one sitting. According to Quimby, the face requires 25 per cent more than the thigh.

For the fields from 0.5 to 2 cm., the erythema was produced by 350 r in 80 per cent of cases and for the fields 3 and 4.5 cm. in diameter, 280 r. It is to be remembered that it is impossible to determine the erythema dose to better than 10 per cent.

To correlate the clinical with the experimental data, the results were analyzed in 50 patients treated in the Head and Neck Service of the Memorial Hospital for carcinoma of the skin by unfiltered roentgen rays (100 kv.). Four were squamous and the rest basal-cell type. Only six received an insufficient amount. In no case did satisfactory regression occur with less than 12.5 "threshold erythema" doses.

In the six who did not show complete regression, three had what should have been a sufficient dose. In the last 18 months, as much as 10,000 r have been administered without delayed or incomplete healing.

S. M. ATKINS, M.D.

Comparative Studies of the Effect of Radiation after Simultaneous Irradiation of Cutaneous Cancer and the Parent Tissue. Paltrinieri and B. Galavotti. Strahlentherapie, **65,** 130, 1939.

The authors undertook comparative studies of the effect of radiation on cancer originating from the skin and on the normal parent tissue (skin) which was exposed simultaneously. Numerous histologic investigations seem to indicate that the normal skin shows an elective reaction following irradiation; the germ cells appear to be more radiosensitive than the prickle cells. A reversed response was seen in the cancerous neoplasms following irradiation. The destruction of skin tumors cannot be explained by the assumption of an epitheliolytic dose; after this dose has been applied it is necessary to go beyond it and keep the malignant tissue saturated by additional irradiation.

In the authors' experience, interstitial radium therapy is to be given preference because it makes possible the application of larger doses into the neoplastic tissue than if treated by a transcutaneous method.

ERNST A. POHLE, M.D., Ph.D.

Primary Carcinoma of the Lung. John B. Flick and John T. Bauer. Pennsylvania Med. Jour., **42,** 873–876, May, 1939.

The incidence of primary cancer of the lung is between 6 and 10 per cent of all cancers.

They may be divided into the circumscribed form which metastasizes late, and the infiltrating form with early metastasis. Secondary deposits many times occur in the brain and may be present before the primary lesion gives rise to symptoms.

The author states that treatment, "by surgical diathermy through the bronchoscope, by radium, or by roentgen rays has not been convincing."

JOSEPH T. DANZER, M.D.

Roentgen Therapy of Skin and Lip Cancer. J. Horvath. Strahlentherapie, **65,** 216, 1939.

The author reviewed the statistics based on surgical and radiological treatment of carcinoma of the skin and lip, and found that a comparison was impossible, chiefly because of differences in classification and calculation of the end-results. During the period from 1917 to 1935, 175 cases of skin and lip carcinoma were seen at the Wintz Institute in Erlangen. They were classified in four stages according to the degree of involvement and the presence of metastases. A single massive dose was used as well as heavily filtered radiation in order to assure homogeneous irradiation. One hundred per cent of the H.E.D. was applied at a distance of at least 70 cm.; this was followed by a second treatment eight or nine weeks later. In carcinoma of the cheek or lip the field includes the entire cervical region; in addition to that a small field limited to the primary lesion alone is exposed with 80 per cent H.E.D. The treatment method developed by Chaoul is also used with a potential of 60 kv. Of 53 cases belonging to Stage I, 96.5 per cent were alive and free from symptoms after three years, 91.1 per cent after five years, 79.4 per cent after eight years, and 64.3 per cent after ten years. Eighteen of these patients lived longer than ten years and 15 of those could be observed for from 11 to 20 years. Of 61 cases belonging to Stage II, 63.9 per cent were still well after three years, 48.1 per cent after five years, 26.2 per cent after eight years, and 21.2 per cent after ten years. The 44 cases of Stage III and the 17 cases of Stage IV are combined in the analysis and the survival figures were: 21.3 per cent (three years), 12.9 per cent

(five years), 6.5 per cent (eight years), and 5.7 per cent (ten years).

In conclusion, the author emphasizes that although the results of radiation therapy in cancer of the skin and lip are excellent, surgical measures have still a definite place in their treatment.

ERNST A. POHLE, M.D., Ph.D.

The Treatment of Buccal Carcinoma. Oliver Chance. Irish Jour. Med. Sci., **160,** 146–156, April, 1939.

The author does not see any antagonism between radiation and surgery in carcinoma of the buccal epithelium, but believes that the two are complementary. There is no doubt that the local lesion should be treated by irradiation, usually radium, because of the good cosmetic results and the excellent therapeutic achievement.

Chance reviews 539 cases and finds the greatest number of cases occur between the ages of 50 and 80 years, as expected, with 86 per cent males and 14 per cent females. No definite predisposing cause is found. Biopsy is done only when necessary to make a diagnosis.

Involvement of the cervical glands is considered a surgical problem and not discussed except in advanced cases in which dissection is impossible, and, curiously enough, some of these cases respond to irradiation.

Of the 539 cases, 57.8 per cent showed involvement of the cervical glands. In carcinoma of the tongue the results of irradiation are better than those of surgery, the death rate is markedly less, and, significantly, the patient still has a tongue.

J. B. MCANENY, M.D.

Results in the Treatment of Carcinoma of the Uterus. H. Goecke. Strahlentherapie, **65,** 409, 1939.

During the years from 1925 to 1933, 303 women with carcinoma of the uterus were treated at the Women's Clinic of the University of Muenster. Two hundred sixty-three of these cancers involved the cervix and 40 the fundus. The following technic was used in the treatment of carcinoma of the cervix: The first radium dose was 2,200 mg.-hr. followed by x-ray deep therapy to the pelvis, administering 110 per cent of H.E.D. effective in the cervix from the sixth to the eighth day after the radium application, using routinely two anterior and two posterior fields and occasionally additional lateral fields. On the eleventh day the second radium application of 2,200 mg.-hr. was given and the patient was discharged two weeks after admission. A third radium application was given six weeks after the first, with the same dose of 2,200 mg.-hr. Four months after the first x-ray therapy, a second series was given with 80 per cent H.E.D. effective in the cervix, and ten months after the first, a third series of x-ray therapy with the same dose as in the second. Since 1934, the third series of x-ray therapy has been omitted because of the occurrence of undesirable local and systemic reactions for which no explanation is offered. The absolute percentage of cure calculated in this group of 263 was 29.2 per cent and the relative percentage calculated on the basis of 80 operable cases treated was 43.7 per cent. Of the 80 operable cases, 26 were operated on and received post-operative irradiation. It appeared that the percentages of cures in this group for operation plus irradiation or irradiation alone were almost equal. The operative mortality was 3.85 per cent; that for the irradiated group 1.2 per cent.

In the group with carcinoma of the fundus, the operative procedure was usually conservative and limited to vaginal hysterectomy without removing the adnexa. In every case post-operative x-ray therapy was instituted; those who were treated by radium alone received the same total amount of 6,600 mg.-hr. according to the same technic used in carcinoma of the cervix. Of the 40 cases with carcinoma of the fundus, 29 were operable and 11 inoperable. The relative percentage of cure for the operable group was 55.1 per cent, and for the inoperable 36.3 per cent, which gives an absolute percentage applied to all cases of 50 per cent. In conclusion it is stated that a recurrence of a carcinoma of the cervix either after operation or irradiation offers a most unfavorable prognosis.

ERNST A. POHLE, M.D., Ph.D.

X-ray Therapy: A Prophylactic Agent in the Prevention of Cancer. R. C. Curtis, Texas St. Jour. Med., **34,** 694–697, February, 1939.

Drawing an analogy from the fact that there are definite precancerous lesions of the skin amenable to x-ray therapy, Dr. Curtis asks why can we not have precancerous lesions in other tissues of the body. He considers cancer of the breast and uterus fertile fields for investigation as to whether or not we may be able to prevent cancer in these tissues.

X-ray therapy of prolonged uterine bleeding and of mastitis should be followed by a lowered incidence of carcinoma of the uterus and breast. Relief of functional disorders by irradiation of the pituitary may be another means of preventing cancer of the breast and uterus. The few facts and data available to date are favorable. The author believes clinical research is as important as laboratory experimentation and in the end will achieve greater success in the understanding of cancer.

JOHN M. MILES, M.D.

Report of the Cases of Carcinoma of the Cervix Treated in 1932 and 1933, at the Cancer Institute in Strassburg. A. Gunsett. Strahlentherapie, **65,** 58, 1939.

In 1932, the author saw 78 and in 1933, 71 women with carcinoma of the cervix; 66 and 64, respectively, were irradiated, with the majority belonging to Stage 3. The radium therapy was carried out in accordance with the method of Regaud. For x-ray therapy 200 kv., 4 ma., 2.2 mm. Cu + 1 mm. Al, 40–50 cm. F.S.D. and two anterior and two posterior fields of 10×15 cm.^{2} were used. An ionization chamber in the vagina controls the depth dose which is carried daily up to from 140 to 160 r until a total depth dose of from 3,800 to 4,000 r has been given. Sometimes three or four sit-

tings through a perineal field with 250 r surface dose per sitting are added. The author emphasizes the importance of combining radium with x-ray therapy. The statistical evaluation of the material is given in six tables. For Stage 3 the relative percentage of cure was 29.5 per cent in 1932, and 39 per cent in 1933.

ERNST A. POHLE, M.D., Ph.D.

Cancer of the Cervix of the Uterus. David B. Ludwig. Pennsylvania Med. Jour., **42,** 894–897, May, 1939.

A series of 284 cases of carcinoma of the cervix of the uterus is reviewed by the author. Of these, 88 per cent were of the squamous-cell type and the remaining 12 per cent were adenocarcinomas; 6.7 per cent were in Group I, 13 per cent in Group II, 43.7 per cent in Group III, and 36.6 per cent in Group IV.

A combination of radium and x-ray was used in the treatment of most of the cases.

JOSEPH T. DANZER, M.D.

The X-ray Treatment of Cancer in Small Communities. Frederick W. O'Brien. New England Jour. Med., **220,** 459–461, March 16, 1939.

The author makes a plea for the establishment of facilities for irradiation of malignancies in small communities by means of moderate voltage equipment. He sees no need for a stampede to supervoltage therapy since it is still in the experimental stage and the present high voltage equipment is well established and its limitations known.

J. B. MCANENY, M.D.

Results of Protracted Fractional Roentgen Therapy of Carcinoma of the Upper Respiratory and Intestinal Tracts from 1930 to 1938. R. Glauner, S. Teufel, and A. Daigger. Strahlentherapie, **65,** 397, 1939.

During the last eight years, 283 cases of carcinoma of the upper respiratory and intestinal tracts were treated at the X-ray Institute of the University of Cologne. The technic was: 180 kv., 4 ma., 60 cm. F.S.D., 1.2 mm. Cu, 6 × 8 or 10 × 12 cm. fields, five or six r/min., from 120 to 240 r/sitting, total doses of up to 8,000 r over two areas. The statistical analysis of the clinical material showed that there were 49 patients with cancer of the mouth; none of these lived at the end of a five-year observation period. The corresponding figures for cancer of the epipharynx were 12 and 0, for cancer of the mesopharynx 90 and 8, for cancer of the extrinsic larynx and hypopharynx 112 and 4, and for cancer of the intrinsic larynx 20 and 2. Most of the patients were inoperable when reporting to the clinic.

The authors conclude, therefore, that after a malignant tumor has grown to a certain extent and especially has grown beyond the organ in which it originated, involving at the same time regional lymph glands, the chances for a permanent cure are exceedingly small. Those who remained free from symptoms for three or five years had very radiosensitive tumors and the glands could be resected surgically. It is emphasized that all regional glands, even if freely movable, should be included in the field of irradiation and, if necessary, be excised afterward. This procedure seems to be safer than excision without preceding irradiation. The authors feel that the protracted fractional dose method has not fulfilled the high hopes which were originally expected although they admit that their cases were in a fairly advanced state when treatment was begun.

ERNST A. POHLE, M.D., Ph.D.

THE CHEST

The Roentgenologic Diagnosis of Thoracic Disease Other than Tuberculosis. Wendell G. Scott. Texas St. Jour. Med., **35,** 5–12, May, 1939.

The diagnosis of intrathoracic disease should be undertaken in an orderly manner, the sequence of procedures being such that one examination will not interfere with subsequent ones. A co-operative group of specialists is required to serve the patient efficiently. The group usually consists of an internist, a thoracic surgeon, a bronchoscopist, and a roentgenologist.

The suggested order of examination is:

1. Clinical history.
2. Physical examination and laboratory work.
3. Roentgenologic procedures:
   - (*a*) Preliminary fluoroscopy.
   - (*b*) Roentgen films using lateral and stereoscopic views.
   - (*c*) Bucky films for study of dense chest shadows.
   - (*d*) Body-section radiography.
   - (*e*) Roentgen kymography for recording of movement.
   - (*f*) Bronchography (lipiodol).
   - (*g*) Therapeutic test by roentgen irradiation.
   - (*h*) Injection of sinus tracts with opaque material.
4. Bronchoscopy.
5. Biopsy of regional lymph nodes.
6. Diagnostic pneumothorax.
7. Individualized procedures:
   - (*a*) Sectioning and examining microscopically pleural fluid sediment.
   - (*b*) Thoracoscopic examination.
   - (*c*) Exploratory thoracotomy.

The basic anatomy and physiology of the lungs and thorax are reviewed in this article and the value and limitations of the various diagnostic procedures are emphasized.

JOHN M. MILES, M.D.

Calcification of a Cold Abscess of the Anterior Thoracic Wall: A Rare Complication in Tuberculous Pleural Effusion. Giovanni Cascelli. Riv. di Pat. e Clin. d. Tuberc., **13,** 380, 381, May, 1939.

Cascelli reports a case of a calcified cold abscess located in the anterior wall of the left side of the chest of a 38-year-old woman who had suffered from a tuberculous pleurisy with effusion some years previously.

The abscess formed gradually at the level of the fifth

rib, growing slowly and painlessly, although tender to the touch, until it assumed the size of a hen's egg. The consistency of the growth was firm and doughy, having been mistaken for a lipoma. A roentgenogram, however, disclosed the true nature of the growth, as well as its position in the thoracic wall. The author quotes Taddei for the possible origin of these abscesses as follows:

1. Spread of infection through the subpleural lymphatics.
2. Infection of a lymphatic ganglion in the intercostal space.
3. Direct extension of any empyema into the connective intercostal tissue.
4. A tuberculous rib, costal cartilage, or vertebræ.

The author considers the condition to be very rare.

A. Mayoral, M.D.

THE COLON

Carcinoma of the Sigmoid Colon (A Radiological Study). A. C. Singleton and M. R. Hall. Canadian Med. Assn. Jour., **40**, 247–252, March, 1939.

The sigmoid is a difficult field of radiological investigation. Methods of examination are the same as those used for the entire colon. These include plain films, barium enema, double contrast enema, and barium meal. Plain films are of more value in obstruction of the large bowel and frequently must be supplemented by a barium enema. The barium enema is standard procedure. The post-evacuation examination and the injection of air per rectum after the patient has expelled practically all of the barium, aid in demonstrating the mucosal relief pattern.

Preparation of the patient's colon for radiological study is important. In uncomplicated cases, castor oil is given the evening prior to a barium enema. To prevent refilling of the colon from the small bowel, food is withheld until three hours before the examination. If a large amount of blood is passed, simple enemas suffice. Sufficient time, approximately three hours, should be allowed for the absorption of retained water. In complete obstruction no preparation is required.

The large fungating or polypoid adenocarcinoma and the scirrhous form occur in the colon. Both produce a change in the mucosal relief pattern and a filling defect. Polypoid carcinoma usually occurs in the right half of the colon, involves a long area of bowel, and prevents contraction. The scirrhous type is more common in the left half of the colon, producing a short annular defect with everted and pouting margins toward the normal lumen above and below.

During a five-year period, the authors administered barium enemas to 6,040 patients of whom 193, or 3.2 per cent, had cancer of the colon. This figure does not include involvement of the rectum as the writers believe this to be a clinical diagnosis. Of these, 80, or 1.3 per cent, had carcinoma of the sigmoid flexure; 59 per cent occurred in men. The average age was 57 years. One patient presented two primary carcinomas, one in the sigmoid and the other in the transverse colon. Three patients had co-existing or pre-existing diverticulitis. In carcinoma of the sigmoid, the radiological findings were corroborated in 88 per cent of the cases.

Three were incorrectly diagnosed diverticulitis, one, "involvement of the colon from without." In six cases the radiological diagnosis of carcinoma was proved by subsequent history to be in error.

The value of repeated examinations was substantiated in this series of cases. A negative radiological report of a colon or stomach examination, in the presence of continued suggestive clinical symptoms or signs, should demand a check-up examination within a month. Early symptoms of carcinoma of the colon and stomach are indefinite and early diagnosis so important that the authors feel very strongly that both should be examined.

M. L. Connelly, M.D.

Roentgenological Consideration of the Colon. Roy G. Giles. Texas St. Jour. Med., **34**, 698–701, February, 1939.

The roentgenologic study of the colon should aim first at demonstrating or ruling out organic lesions of the colon, and second, at excluding organic disease elsewhere in the body. Other diagnostic procedures are, of course, necessary. If no organic disease is found, one must then analyze the patient's physical and mental make-up, his environment, and social and financial status before making a diagnosis of functional disorder.

The usual findings of organic pathology as shown by the barium enema are discussed and the technic of a satisfactory barium enema is outlined. Of interest is the author's experience that approximately 1 per cent of patients with hemorrhoids have associated carcinoma of the colon.

John M. Miles, M.D.

Cellulitis of the Colon: A Manifestation of Diverticulitis. W. A. Hailes. Australian and New Zealand Jour. Surg., **8**, 270–279, January, 1939.

In the author's experience, true acute intestinal obstruction complicating diverticulitis is a consequence of an acute phlegmonous inflammation of the involved segment of colon wall, rather than a sequel to adhesions or peridiverticular abscesses. The course of this inflammatory process may lead to spontaneous resolution, abscess formation, or intestinal obstruction. If an abscess forms, it may drain spontaneously into the lumen or become walled-off in the pelvis and require external drainage. Obstruction, although relatively uncommon, results both from the obliteration of the lumen by inflammatory swelling and by its paralytic effect on the muscular coats of the involved segment. As the disease is most common in patients past middle age, it must be especially differentiated from other inflammatory lesions in the pelvis and from carcinoma of the colon. Differential criteria are: first, the occurrence of fever and elevation of the pulse and leukocyte count in older individuals, with localized tenderness and rigidity of the lower quadrants of the abdomen (usually

the left side); second, significant radiologic finding of the presence of diverticula, a relatively long ragged (spastic) filling defect as compared to that usually noted with carcinoma, and third, usually less obstructive dilatation to the proximal segments of colon than is generally noted with carcinoma.

The author believes conservative measures in the uncomplicated cases of cellulitis of the colon, as in cellulitis elsewhere, is the treatment of choice, allowing for resolution and drainage into the lumen of the bowel. If there is a progressive or rapidly developing obstruction, colostomy is necessary. Transverse or iliac colostomy is preferred. (Extensive bowel resections are seldom, if ever, necessary.)

The author describes in detail six cases from a large group in his experience. The cases reviewed all had marked cellulitic inflammation and very little peritoneal and peridiverticular involvement.

SIMON POLLACK, M.D

THE ESOPHAGUS

Achalasia of the Esophagus. Richard Flynn. Australian and New Zealand Jour. Surg., **8,** 244–262, January, 1939.

The author discusses cardiospasm as the physiologico-pathologic complex wherein there is a failure of the cardiac sphincter to relax in the process of deglutition. The unrelaxed sphincter can be overcome by the pressure of 20 cm. of fluid; this results in the intermittent relaxation when the esophagus is completely filled.

As regards the etiology, the prevailing opinion is that the disease is secondary to degeneration of the intrinsic Auerbach plexus neurones. The vagus nerve controls the tonic contraction of the striped muscle in the upper third of the esophagus, maintains the tone and motility of the smooth muscle in the lower two-thirds of the esophagus, and causes relaxation of the cardiac sphincter. Bilateral vagal section in experimental animals has recently been shown by Knight to reproduce the clinical syndrome of achalasia. Postmortem studies recently by Rake, at Guy's Hospital, London, have shown degeneration of the cells of Auerbach's plexus in six cases of this condition. These facts suggest a possible cure by the surgical obliteration of the unbalanced sympathetic innervation to the esophagus in cases of cardiospasm.

Clinically, the disease is seen in all age groups and in both sexes with about the same frequency. The author refers to Plummer's classification.

(1) Achalasia without regurgitation, characterized only by substernal pain on deglutition.

(2) Achalasia with immediate regurgitation of food.

(3) Achalasia with dilatation of the esophagus, retention of food in the esophagus, with regurgitation at irregular intervals after ingestion.

The characteristic case reveals a slow insidious onset of symptoms over a long period of time. The difficulty is present equally for both liquid and solid foods and the regurgitated material does not contain acid (gastric juice). The regurgitation is not an emesis as there is no nausea and the gastric and abdominal reflexes do not come into play. Pain may be present, and, if so, it is usually substernal and is noted when material is forced through the unrelaxed sphincter. Because the sphincteric obstruction can be overcome by a hydrostatic pressure of 20 cm., the patients usually find they can force deglutition by drinking water and then swallowing with the aid of the voluntary muscles of the pharynx and neck, with the chin against the chest. Diagnosis is made by radioscopic and radiographic examinations. Passage of a diagnostic bougie over a swallowed silk thread may be used for confirmatory evidence.

In the differential diagnosis, all other causes of dysphagia must be considered. Carcinoma of the esophagus usually presents a history of shorter duration, occurs in older age groups, and may often show occult blood in the stool, the last finding never being noted in achalasia. Extrinsic pressure on the esophagus, either from mediastinal tumor masses, substernal thyroid, or aneurysms, as well as stricture, foreign body, and diverticulum of the esophagus must also be differentiated. This can best be done by the roentgenologic examination. Neurogenic causes, such as bulbar palsy, myasthenia gravis, and hysteria, must also be differentiated. Lastly, lesions in the cardiac end of the stomach, especially para-esophageal hernias and carcinomas of the cardia, may cause dysphagia. These lesions also are best differentiated by radiologic examination.

In treatment, the author recommends dilatation by a hydrostatic bag passed over a silk thread. The guide thread prevents accidental perforation of the esophagus. No anesthetic is used, as the substernal pain on dilatation is the best guide as to its adequacy. The air and mercury dilators are not considered as efficacious. Esophagoscopy is hazardous in these cases, as the esophagus may be so dilated and elongated that it is *S*-shaped.

The author's series of eight cases, three in females and five in males, all showed successful response to only one dilatation. One case has been followed for over seven years.

SIMON POLLACK, M.D.

Peri-esophageal Abscesses: The Importance of Early Surgical Interference. Westley M. Hunt. Ann. Otol., Rhinol., and Laryngol., **48,** 128–139, March, 1939.

Twenty cases of infection of the peri-esophageal tissues in the cervical region following rupture of the esophagus are analyzed. Rupture of the esophagus may be due to the swallowing of a foreign body, trauma from instrumentation, or spontaneous rupture accompanying malignancy. Not all perforations are necessarily followed by infection. The diagnosis of cervical peri-esophageal infection is made by the suspected or observed perforation of the esophagus by a foreign body, instrument, or malignancy; the marked collapse of the patient at the time of perforation; pain, tenderness, and swelling over the area; inability to swallow; absence of dyspnea unless pneumothorax has occurred;

sudden rise in temperature; definite roentgenologic evidence of widening of the pre-vertebral space; emphysema.

The roentgenogram is the determining factor in diagnosis and aids in differentiating between simple cellulitis, from which recovery might occur, and abscess formation, with a bubble of air. Daily roentgenograms should be made following any known perforation. The surgical treatment is discussed and the cases analyzed. The perforation was caused by a foreign body in 17 of the 20 cases, by instrumentation in one, and two followed biopsy. Sixteen were operated upon and external drainage established, with 12 recoveries. Four were not operated upon, and all died. Reproductions of roentgenograms are included, showing the value of this diagnostic measure.

LESTER W. PAUL, M.D.

FISTULÆ

Roentgenologic Demonstration of Fistulæ between the Biliary System and the Intestinal Tract. Réné du Mesnil de Rochemont. Röntgenpraxis, **11,** 156–165, March, 1939.

A filling of the biliary system by air or the entrance of contrast material into the biliary tract during a gastro-intestinal examination is seen most often after a surgical anastomosis (choledocho- or cholecystoduodenostomy).

If surgery has not been done, the next frequent cause is a spontaneous fistula which is usually due to a perforation of the gall bladder into the intestinal tract, sometimes to a perforation of a chronic duodenal ulcer, and rarely to a perforation of a cancer. In extremely rare cases, an air- or barium-filling of the biliary ducts has been reported without the presence of a fistula; it has been thought to have been caused by an insufficiency of the sphincter of Oddi. A pull on the papilla from an old duodenal ulcer seemed to have been the etiologic factor in these cases.

Several cases are reported by the author. There is an extensive bibliography pertaining to this subject.

HANS W. HEFKE, M.D.

FRACTURES

Acute Osteomyelitis of a Vertebral Body Following Compression Fracture. Rodney F. Atsatt. Jour. Bone and Joint Surg., **11,** 346–352, April, 1939.

The author presents a case of a patient who fell and sustained a compression fracture of the second lumbar vertebra. Two weeks after injury the patient had a chill and rise of temperature during treatment for the previously observed vertebral fracture. This is recognized as the onset of the infectious process in the fracture site. After consultation and repeated films of the spine, a diagnosis of osteomyelitis of metastatic origin was made. The patient subsequently died from toxemia and examination showed osteomyelitis of the spine.

Review of the literature shows that osteomyelitis of the vertebral body is mistaken for a Charcot degeneration or tuberculosis, the latter more frequently. In the case at hand the diagnosis of osteomyelitis following compression fracture was made and it was proved at autopsy.

J. B. MCANENY, M.D.

A Fluoroscopic Technic for Nailing Fractures of the Neck of the Femur. Lawrence V. Littig. Wisconsin Med. Jour., **38,** 373–375, May, 1939.

The author describes a technic for nailing fractures of the neck of the femur under fluoroscopic control. He makes use of a specially designed nail guide which is positioned under the guidance of the roentgenologist and allows accurate insertion of the nail with fewer check films than are required with the usual methods.

LESTER W. PAUL, M.D.

Operation for Fracture of the Olecranon. Naughton Dunn. British Med. Jour., **1,** 214, Feb. 4, 1939.

In a very concise article, this author reviews the methods of treatment of fracture of the olecranon process and describes results he has obtained in cases in which the small fragment was simply removed at once. The triceps tendon was, of course, repaired and sutured. It is pointed out that in many cases of fractured elbow involving the olecranon process, the small fragment is eventually removed and that the period of disability could have been shortened had this been done with the initial treatment.

Q. B. CORAY, M.D.

Fracture of the Elbow and Volkmann's Ischemic Contracture. Henry W. Meyerding. Minnesota Med., **22,** 100–104, February, 1939.

The common fracture associated with this complication is the supracondylar type. Hemorrhage in these cases is confined, and its tension produces muscular damage. The damage is done in a matter of hours, not days or weeks. The forearm, hands, and fingers become pale, cold, and cyanotic; blebs appear.

The treatment includes prompt stretching of the contracture. Metallic splints are fitted to the fingers, the wrist usually being found flexed, and extension is brought about gradually. Tongue depressors, padded and fitted to the fingers, make very good splints. With these, the principle of Jones may be carried out. The use of rubber bands to pull out the fingers is also good. The banjo splint is an excellent device.

In cases of long standing in which extension is prevented by definite contractures and cicatrization, surgery must be resorted to. Tendon lengthening, neurolysis, section of the pronator quadratus or pronator teres are mentioned. Resection of bone may even be resorted to.

PERCY J. DELANO, M.D.

Fractures of the Neck of the Femur: Review of 33 Consecutive Cases. S. T. Irwin. British Med. Jour., **1,** 199–204, Feb. 4, 1939.

The author of this article endeavors to clarify the situation of the nailed fractured femur as regards opti-

mum time for application, applicability, mortality and probability of bony union. The paper deals with 33 patients ranging in age from 43 to 83 years. The Smith-Peterson nail was used in all cases with the Hey-Groves direction finder (technic is described minutely). Of all the patients operated on in various ways, bony union occurred in 70 per cent, whereas in those in whom the introduction of the "nail" was successful, 80 per cent got good bony union. Of these, 50 per cent have perfect function after three years and all have painless weight-bearing.

The optimum time for nail insertion is one week after the fracture. The process causes little or no surgical shock and the patient is on crutches in from six to eight weeks. X-ray plates are used as a check in maintenance of position of fragments and progress of union.

Q. B. Coray, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Gallstones: Ten Years' Surgical Experience. Lancelot Barrington-Ward. British Med. Jour., **1**, 431–433, March 4, 1939.

The author gives a convincing discussion of the condition of gallstones based on his series of 209 cases which came to operation during 10 years. Calculus cholecystitis is discussed as follows:

The universal cause is infection; no age is exempt; female cases exceed male cases at a rate of 3 to 1. The former tend to be fat and the latter thin. Nearly all women with gallstones are married and have had children. The clinical features are variegated: colic seems to be the most salient with generally disordered gastro-intestinal function between attacks. A differential diagnosis must be made between duodenal ulcer, appendicitis, and, occasionally, coronary disease. The x-ray findings are considered very helpful in making the differentiation.

There is no medical treatment. The author feels that surgery should be resorted to early and regrets the fact that cholecystectomy has had a rather bad reputation with some practitioners. Stone in the common duct is cited as one of the serious complications which may be avoided. Obstructive jaundice calls for early operation, whereas acute cholecystitis does not.

It is observed that gallstones occur in children much more frequently than is generally supposed.

Q. B. Coray, M.D.

Roentgenologic Study of the Gall Bladder and Bile Ducts. W. M. Barron. Texas St. Jour. Med., **34**, 846–848, April, 1939.

The maximum accuracy of diagnosis following gall-bladder visualization depends upon careful examination and avoidance of pitfalls. The author uses the oral method, employing in difficult cases "intensifying technics" and multiple radiographs in various positions, such as left oblique, lateral, and erect. The only real deterring factors in the attempted visualization are, he considers, pyloric and intestinal obstruction or severe diarrhea which prevents absorption.

When the gall bladder fails to visualize, a 14 × 17 in. roentgenograph of the abdomen is made to show a possible displaced gall bladder and to show the amount and condition of the dye. A fatty meal is given even after non-visualization, since subsequent films may show a good concentration of the dye. A second examination at a later date may show normal visualization if the first non-visualization is due to a transitory inflammatory condition.

John M. Miles, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Mesenteric Lymphadenitis. Arnold Schwyzer. Minnesota Med., **22**, 277–280, April, 1939.

Two cases are reported. In the first, a young woman, 20 years old, had an appendectomy for acute appendicitis. She had recurrent abdominal symptoms a month later. Six months after the operation the symptoms became acute one night and laparotomy was undertaken. In the pelvis was a stiff ballooned bowel, strangulated by a band which ran from the meso-ileum over to the mesosigmoid. On manipulation, the attachment of the constricting band broke away from a roundish mass, of the size of a small walnut, at the root of the meso-ileum. This was an enlarged and infected lymph node. It was overlaid with meso-ileum and the abdomen closed. Convalescence was uneventful.

The second case was that of a woman 54 years of age. With acute symptoms suggesting appendicitis, laparotomy was done. The appendix was reddened but did not appear to be a logical cause for symptoms as severe as those the patient presented. The McBurney incision afforded access to the meso-ileum. About a foot up on the bowel a large abscess with a *B. coli* odor was encountered. Drainage was instituted and convalescence was uneventful.

The theory here was that drainage from a chronically infected appendix, which was demonstrated pathologically, had centered in this lymph node with subsequent abscess formation.

Percy J. Delano, M.D.

Idiopathic Benign Hypertrophic Pyloric Stenosis in the Adult. Francis E. Kibler. Minnesota Med., **22**, 373–380, June, 1939.

This condition was first recognized, in 1835, by Jean Cruveilhier, and Boas, in 1898, reported two cases. According to R. Rossle, specific examination in over 5,000 autopsies performed in Berlin and Basle, revealed that 3 per cent of adults are so afflicted.

Some have thought that these cases represent mild forms of the congenital condition; others have thought them to be secondary to alcohol and gastritis, from various causes.

The symptoms, sometimes quite intermittent, are those of pyloric spasm or obstruction. Duodenal ulcer may be simulated. As the obstruction manifests itself, the periodicity is lost and attacks are longer and finally merge one into another. Hemorrhage is unusual, but loss of weight is common.

Diagnosis must be made principally from pylorospasm, and the use of atropine here is quite valuable. Sometimes there is difficulty in ruling out forms of duodenal stasis, particularly those cases in which a ptotic and mobile kidney draws the duodenum downward, giving rise to one of the varieties of Dietl's crisis. Other conditions to be differentiated are duodenal compression by the superior mesenteric artery or by the middle colic artery in the presence of a short mesocolon, in which condition symptoms are present when colon is full; congenital bands, and calcified retroperitoneal lymph nodes.

Chronic duodenal obstructions do not produce muscular hypertrophy of the pylorus.

The final diagnosis rests principally with x-ray examination, of which fluoroscopy is the most important. It is generally conceded that a concentric pyloric defect with an elongated narrow canal and intact mucosal relief establishes the diagnosis.

Golden has stressed the demonstration of mucosal pattern in the pylorus as a critical point. According to Kirklin and Harris: "Concentric indentation of the bulbar base in conjunction with prepyloric narrowing is pathognomonic of pyloric hypertrophy."

The treatment is essentially surgical.

PERCY J. DELANO, M.D.

Roentgen Diagnosis of Diseases of the Ileocecal Region of the Gastro-intestinal Tract. Joseph Jellen. California and West. Med., **50**, 267–269, April, 1939.

The author continues his review of the non-specific granulomas affecting the terminal ileum, and discusses, comprehensively, lymphoblastomas, intussusception, diverticulitis, mesenteric adenitis, and localized ulcerative colitis. He describes the clinical as well as the roentgenologic findings and the etiology of these lesions.

The frequency of disease in this area is emphasized and also the fact that it is the part of the gastro-intestinal tract most neglected by radiologists.

JAMES J. CLARK, M.D.

GOITER

Hyperparathyroidism Associated with Osteitis Fibrosa Cystica. H. S. Sharpe. Canadian Med. Assn. Jour., **40**, 164, 165, February, 1939.

A case of hyperparathyroidism with classical signs and symptoms is presented. A man, 52 years of age, suffered one attack of renal colic, two years later gastro-intestinal distress, excessive thirst, polyuria, and asthenia accompanied by enlargement of the left half of the thyroid. The basal metabolism was −10 per cent. It was assumed that these findings indicated glandular dysfunction. Extracts of thyroid and whole pituitary gland were administered.

The patient returned four years later complaining of generalized aches and pains. Films revealed cystic changes of the right fourth metacarpal and first phalanx of the right fourth finger, of the right tibia, ramus of left mandible, the left clavicle, and a general granular appearance of the skull. Blood chemistry showed an elevation of the calcium to 17.4 and phosphorus 2 mg. per 100 c.c. An adenoma of the parathyroid was removed that probably is the largest reported. It measured 7 × 6.5 × 4 cm. and weighed 120 grams. Nine days post-operative, the blood chemistry had returned to normal while the bone pathology gradually subsided. The patient has since remained symptom-free.

M. L. CONNELLY, M.D.

HEART AND VASCULAR SYSTEM

Coarctation of the Aorta: Report of a Case with Rupture Distal to the Constriction. John T. Hecker. Jour. Iowa St. Med. Soc., **29**, 240–245, June, 1939.

A case of coarctation of the aorta is reported in which rupture of the aorta occurred below the constriction. The patient was 62 years of age, and had worked as a railroad engineer up to a short time before his death. Autopsy revealed an almost complete stenosis of the aorta about one and one-half inch distal to the origin of the subclavian artery. A review of the classification, clinical diagnosis, physical and roentgenologic signs, of coarctation is given. A bibliography of 20 references is appended.

LESTER W. PAUL, M.D.

Coronary Thrombosis among Persons Less than Forty Years of Age: A Study of Thirty Cases. William H. Goodson, Jr., and Frederick A. Willius. Minnesota Med., **22**, 291–293, May, 1939.

Thirty cases are reviewed by the authors, in which all but three were between the ages of 30 and 39. There were 24 males and six females. None of the previous histories was remarkable, but 73 per cent of the patients were smokers. In eight cases there were anginal symptoms varying in duration from one day to six months, the average duration being a month and a half. In the remaining 22 cases, the onset was without previous symptoms. In three cases the attack was without pain; one patient experienced nausea, another a feeling of suffocation, another distention.

Three patients were engaged in strenuous work when the arterial closure occurred; eight in moderate activity; four had just finished a meal; three had just awakened from sleep; the status was indeterminate in the others.

Electrocardiograms of 24 patients showed characteristic findings. In six others electrocardiograms made after an interval were essentially normal. The infarcts were in the anterior wall of the left ventricle in nine cases, as indicated by electrocardiographic patterns. In 15 cases the lesion was in the posterior basal portion of the left ventricle, the region customarily supplied by the branches of the right coronary artery.

At the time of the conclusion of this study, eight patients were dead—a mortality of 26.6 per cent. Their average survival period following the first occlusion was 22 months. Two died the day of the second occlusion.

The autopsied cases were five in number: four males and one female. Four showed atherosclerosis. The fifth case was that of a pregnant woman in which it

could not be determined whether the occlusion preceded or followed a fall which resulted in a head injury. In her case there was no atherosclerosis. The authors concluded that the essential findings of coronary occlusion do not differ in this group of young patients from those observed in more advanced ages. They also believe this disease to be on the increase.

PERCY J. DELANO, M.D.

Roentgen Irradiation of the Thyroid in the Treatment of Cardiac Decompensation. G. Pellegrini. Strahlentherapie, **65,** 330, 1939.

The author advocates roentgen therapy directed to the thyroid in patients with cardiac decompensation. He administers 3 × 80–100 r per week (160 kv., 1 ma., 0.5 mm. Cu + 3 mm. Al). In his opinion the beneficial effect is directly related to the reduction of the O_2 consumption which occurs usually from 10 to 24 hours after the treatment. An illustrative case is reported in detail.

ERNST A. POHLE, M.D., Ph.D.

Essentials in the Diagnosis of Congenital Heart Disease. Thomas J. Dry. Minnesota Med., **22,** 78–89, February, 1939.

Dry reviews the embryology of the cardiovascular system, pointing out the lack of septa in fishes and reptiles. Small interventricular defects, such as the maladie de Roger, resemble the adult form of heart in some of the higher reptiles. There is a transitory stage in the human heart at which there are two aortæ connected with the left ventricle, each with two cusps. In the process of torsion, the right aorta is obliterated whereas the left remains open to become the outflow chamber of the left ventricle. If this process is arrested, the aorta is left in a dextroposed position, in which case the right aorta persists in place of the left, or the right and left aortæ may fuse to form a large aortic trunk. In either case this dextroposed aorta, instead of bearing the normal relationship to the left ventricle, overrides the interventricular septum (which is usually incomplete) and the right ventricle. In other words, the great vessels are transposed, and the transposition may be present in varying degrees, depending on the degree of torsion that has occurred.

Here, then, one sees the genesis of one of the most interesting anomalies, namely, the tetralogy of Fallot. This consists of dextroposition of aorta, with an interventricular defect, pulmonary stenosis, and an hypertrophied right ventricle. Cusp anomalies are frequent concomitants.

There are six pairs of aortic arches, not all present at the same time. The left fourth arch becomes the aortic arch; the right fourth arch forms the innominate artery and the beginning of the subclavian artery. The sixth arch gives origin to the pulmonary artery, and on the left side to the ductus Botalli.

Coarctation of the aorta is frequently associated with aneurysms of the circle of Willis.

In the diagnosis of maladie de Roger, the thrill and bruit are the cardinal points, best elicited in the third and fourth left interspaces and conducted toward the apex. The second pulmonic sound is not accentuated. The heart's shape is usually normal.

Interauricular septal defect, or patent foramen ovale, may give rise to cyanosis, right ventricular hypertrophy, enlargement of the pulmonary artery and of the right auricle.

In Lutembacher's disease (mitral stenosis with interauricular septal defect), there is roentgenologic evidence of pulmonary dilatation (sometimes simulating mediastinal tumor); hypertrophy of right ventricle; small aortic knob; blunt, rounded apex.

In subaortic stenosis there is a systolic bruit at the base, and evidence of left ventricular hypertrophy.

The syndrome of pulmonary stenosis consists of polycythemia, hypertrophied right ventricle, clubbing, prominent conus, and enlargement of the right auricle.

In patent ductus arteriosus, continuous murmur, Gerhardt's ribbon dullness (dullness in the second and third left interspaces), and a prominent conus shadow comprise the syndrome.

In coarctation of the aorta there is evidence of collateral circulation with erosion of under surface of ribs, hypertension in upper extremities and diminished tension in the lower extremities.

Coronary anomalies reported include a case of single coronary vessel with anoxemia as well as one of a "water-bottle" shaped heart, resembling pericardial effusion and which was associated with intraventricular conductive disturbances in the electrocardiogram.

The uncomplicated defects of the septa, patency of the ductus arteriosus, subaortic stenosis, and persistent right aortic arch may interfere with activity only to a limited extent, but the frequent occurrence of subacute bacterial endocarditis as a complication renders their prognosis guarded. Occasionally, an individual with a gross cardiac defect lives to an advanced age.

PERCY J. DELANO, M.D.

THE HIP JOINT

Secondary Necrosis of the Head of the Femur after Traumatic Dislocation of the Hip Joint in a Fourteen-year-old Patient. Hans-Heinz Mutschler. München. med. Wchnschr., **86,** 258–260, Feb. 17, 1939.

A 14-year-old boy suffered traumatic dislocation of the left hip. This was reduced without difficulty and immobilized in plaster; he was able to walk without pain in seven weeks. A year later he returned because of a painful hip, and roentgenograms showed an aseptic necrosis of the femoral head, with marked flattening. The author felt this patient was too old for the development of Perthes' disease, as this usually begins between the sixth and ninth years. Therefore, he concluded that this was a late result of the trauma. While such necroses are hardly surprising on anatomical grounds after some types of fracture, the occurrence after a simple dislocation is less easily explained. Nutritional changes due to tearing of the vessels in the capsule and ligamentum teres are thought by Blumen-

saat and others to be the cause, while Volkmann believes it to be a primary injury of the bony trabeculæ in the spongiosa of the head. The author cites reasons for believing the first explanation untenable, and that the elucidation of the cause lies in the direction of structural weakness of the bone.

LEWIS G. JACOBS, M.D.

Arthrography in Congenital Dislocation of the Hip. Eric Severin. Jour. Bone and Joint Surg., **11,** 304–313, April, 1939.

In order to delineate the cartilaginous and ligamentous structures about the acetabulum, Severin has resorted to arthrography which is done by injecting an opaque medium into the capsule of the joint. Bayer's special perabrodil for joints is used, after diluting it to a 17.5 per cent solution. The injection is made with needle and syringe from the anterior aspect, directing the needle from just below Poupart's ligament and about one centimeter laterally from the femoral artery, posteriorly toward the acetabulum. From about three to three and one-half c.c. of solution is sufficient. A film is taken of the pelvis in the prone position and one with the thighs in flexion and abduction.

By this procedure, the cartilaginous acetabulum is well outlined and defined, together with the cartilaginous head of the femur. The difference between dislocation of the hip and subluxation can be seen. Progress after reduction can be closely watched, with repetition of the procedure.

J. B. MCANENY, M.D.

INFLAMMATION

Radiation Therapy in the Treatment of Inflammatory Lesions. Fred O. Coe. New England Jour. Med., **220,** 471–474, March 16, 1939.

The author believes the reason that so few physicians refer inflammatory conditions for irradiation is because of a general lack of knowledge and fear that the treatment itself might be injurious. He insists that the dosage is well below that which might cause damage, and should never exceed a half erythema dose. The efficacy is probably due to the destruction of leukocytes with the liberation of antibodies. The more marked the inflammatory process and the earlier it is treated the better the results will be.

Puerperal mastitis responds well to dosages of 160 r given at 112,000 volts, through 3 mm. Al which may be repeated in three days. Acute mastitis is treated at the same voltage, giving 160 r the first day and 100 r the third and fifth days.

Furuncles and carbuncles respond well in the author's experience with relief of pain in from six to 24 hours.

Erysipelas responds to a dose of 160 r at 112,000 volts through 3 mm. Al, exposing a margin well beyond the infection.

Pneumonia with delayed resolution is usually cleared by irradiation.

Pneumonia, both lobar and bronchial, is now treated with irradiation, giving from 200 to 300 r at 200 kv. through 0.5 mm. Cu, with good results. Usually only one treatment is necessary but sometimes two or three are needed.

Cervical adenitis almost invariably shows resolution soon after irradiation. The dose is from 100 to 160 r at 112,000 volts through 3 mm. Al, on alternate days for three treatments.

Sinusitis, especially that found in children, responds well to from 100 to 120 r at 112,000 volts through 5 mm. Al each to right, left, and anterior face areas, and repeated until six series of treatments have been given.

J. B. MCANENY, M.D.

The Value and the Limitations of Radium and/or Roentgen Irradiation in Acute Inflammatory Processes. M. Ponzio. Strahlentherapie, **65,** 195, 1939.

The author discusses briefly the theoretic foundations of the use of x-rays and radium in the treatment of inflammatory diseases. Since it has been established that the radiosensitivity of the bacteria is extremely low, the beneficial effect on inflammatory processes cannot be a direct one but is in all probability due to an indirect action on such tissue elements the function of which is to counteract infection.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy in Inflammatory Disease. J. N. Collins. Jour. Indiana St. Med. Assn., **32,** 322–324, June, 1939.

The author deplores the infrequent use of irradiation in inflammatory conditions and makes a plea for its more frequent application. Several authorities are quoted to substantiate claims.

Some of the various conditions amenable to irradiation are furuncle; carbuncle; folliculitis of the nares; erysipelas, using small doses and treating well beyond the margin; parotitis complicating surgical procedures; secondarily infected fungus process on the hands of laborers; bursitis, especially subacromial; infections following a human bite; trachoma; tuberculous adenitis; tuberculosis of the cornea and iris; warts, especially the plantar type; blastomycosis; actinomycosis; arthritis, followed by the relief of pain, especially the hypertrophic type.

J. B. MCANENY, M.D.

THE LUNGS

Primary Sarcoma of the Lung with Brain Metastasis. Ralph C. Ellis. Jour. Kansas Med. Soc., **40,** 243–245, 254, 255, June, 1939.

In a series of 7,272 autopsies performed by the Department of Pathology of the University of Kansas Hospitals, there have been 38 cases of primary malignant tumor of the lung, an incidence of 0.52 per cent. There has been, however, only one case of primary sarcoma. In this case the first clinical manifestations were due to the brain metastasis. Because of the clinical symptoms, a diagnosis of brain tumor was made and

operation performed. Biopsy revealed spindle-cell sarcoma. The patient died post-operatively. At autopsy the primary tumor, a spindle-cell sarcoma, was found just beneath the pleura of the right middle lobe in the anterior axillary line.

LESTER W. PAUL, M.D.

Late Results of Thoracoplasty. Herbert A. Carlson, Herbert A. Burns, and Owen H. Wangensteen. Minnesota Med., **22,** 294–298, May, 1939.

The authors present an exhaustive review of the subject. The lesions were classified and grouped preoperatively. The technic of thoracoplasty is described and the results are grouped and classified. They note that their end-results appear to be somewhat better than those reported by Hedblom and Van Hazel (which includes the work of Bull, Key, Schedtler, Denk, and others). In their conclusions they note:

1. A survey of the fate of 50 thoracoplasty patients from 18 months to 12 years after operation reveals that 76 per cent are living, the remaining 24 per cent are dead.
2. The primary case operative mortality was 2 per cent; the stage operative mortality, 0.7 per cent.
3. One-half the patients (50 per cent of the entire group) have both closed cavities on x-ray examination and negative sputum, including guinea pig inoculation.
4. Comparison of x-ray films shows that improved collapse has followed the modifications in technic of the operation.
5. The results of thoracoplasty are determined primarily by the pathologic characteristics of the pulmonary disease of patients selected for operation.

PERCY J. DELANO, M.D.

Combination of Sinusitis and Non-specific Inflammatory Affections of the Lung. Sven Roland Kjellberg. Acta Radiol., **20,** 147–149, April, 1939.

A complete x-ray examination of both paranasal sinuses and lungs is advocated for all cases in which one of these organs is diseased, since it has been proved by experience that sinusitis is frequently combined with non-specific inflammatory lung affections, and *vice versa*.

ERNST A. SCHMIDT, M.D.

Single Large Cyst of the Lung Simulating a High-pressure Pneumothorax. E. B. Hudson. British Med. Jour., **1,** 503, 504, March 11, 1939.

This rather concise article should be of interest to radiologists for the reason that it describes one of those rare cases by which any of us may be "tripped up" sooner or later.

A six-month-old infant suddenly became cyanotic, presenting a picture of extreme fear and pain and finally turned cold and sweaty. This picture was repeated following a short interval of partial recovery, during which the findings at a clinic were normal. Two weeks later, a diagnosis of pneumothorax was made and a radiologist changed this to lung cyst, due to the presence of lung structure at the apex and base apparent in the radiograph. Following attempts at surgical removal, the child died of bronchopneumonia. A trocar had been inserted previously.

The author feels that such cases of lung cyst might be saved if a correct diagnosis were made at first. Most have been mistreated as cases of pressure pneumothorax, the results being total collapse of the lung and death from mediastinal displacement.

Q. B. CORAY, M.D.

Treatment of Chronic Suppurative Disease of the Lung. Thomas J. Kinsella. Minnesota Med., **22,** 223–232, April, 1939.

The author takes up pulmonary abscess, gangrene, infarct, bronchiectasis, and the chronic suppuration now being recognized with increasing frequency in the course of pulmonary tuberculosis secondary to bronchial stenosis and frequently inappropriately called tuberculous bronchiectasis.

There is still discussion as to whether lung abscess is the result of aspiration or of septic emboli. The lung has great powers of repair if it can be drained. Unless an abscess is draining through a bronchus it is foolish to expect much of postural drainage. Bronchoscopic drainage occurs mostly through the dilatation of strictures, by removing granulation tissue, by removing foreign bodies, and by removing dead tissue from the abscess itself.

External aspiration is dangerous, as is artificial pneumothorax. The best localization is by roentgen examination, films made in the postero-anterior and lateral positions. They are better than stereoscopic films. Mention is made of tomography and planigraphy. Phrenicectomy is not an operative procedure that should become popular in lung abscess, nor is thoracoplasty.

Surgical drainage is the method of choice when palliative measures have failed to give any encouragement. The methods of sealing the pleura are discussed. Delay in establishing surgical drainage may permit the process to become multilocular, metastasis to occur, or empyema to complicate the condition.

Bronchiectasis is a condition and not a primary disease. It is commonly secondary to pulmonary abscess, foreign body, tumor, tuberculosis, or a number of other conditions in which association of infection with bronchial stenosis or some other disturbance of drainage leads to weakening of the bronchial wall, dilatation, and cavity formation. About one-half of these patients have some hemoptysis, more frequently on a percentage basis than in patients with tuberculosis. Later, dyspnea, clubbing of the fingers, watch-crystal nails, etc., develop. Diagnosis is by means of roentgenography following the injection of iodized oil.

Treatment includes that of constitutional conditions, respiratory infections, sinus disease, postural drainage, bronchoscopic manipulation, and the more radical surgical procedures: thoracoplasty, lobectomy, cautery lobectomy, pneumonectomy.

When resulting from tuberculous stenosis of bronchi, treatment must be undertaken differently. Danger of dissemination of the tuberculous process alters the ra-

tionale of some of the procedures. When patients have advanced retention of secretion and are desperately ill, the Graham cautery type of external drainage has given good results in the author's hands. For the patient who already has had collapse therapy with obliteration of the pleural cavity, primary lobectomy may be preferable.

PERCY J. DELANO, M.D.

PEPTIC ULCER

Duodenal Ulcers Located at the Distal Portion of the Cap, and Ulcers of the Duodenum beyond the Extrabulbar Cap. Ludovico Mucchi and René Martinet. Radiol. med., **26**, 289–305, April, 1939.

Dr. Mucchi and Dr. Martinet, of Milano, have made a clinical and radiologic study of what they call extrabulbar ulcers, that is, ulcers located at the extreme portion of the duodenal bulb or distal to it. The work is based on the radiologic and clinical examinations of 398 duodenal ulcers discovered among the material seen at the surgical clinic of the University of Milan. All cases were confirmed surgically.

In this essay the authors emphasize the accuracy of the radiologic examination and show that extrabulbar ulcers can be readily localized by the method. Clinically, the differential diagnosis is difficult if not impossible. In their experience about 7.6 per cent of duodenal ulcers are extrabulbar, the proportion between females and males being nine to one in favor of the former. These writers have found that the radiologic signs can be summarized into two groups, direct and indirect, the direct being (*a*) the niche, (*b*) point tenderness at the site of the niche, (*c*) incisure opposite to the site of the niche, (*d*) spastic narrowing of the intestine at the site of the ulcer. Indirect signs are: (*a*) flabby dilatation of the intestine at the site of the ulcer, (*b*) a permanent or transitory disappearance of the valvulæ conniventes, (*c*) physiologic as well as morphologic alteration of that portion of the duodenum located at or near the ulcer. The pathognomonic sign, however, is the niche, and this can be found by diligent search. Several excellent prints of radiograms illustrating the niche accompany the article.

A. MAYORAL, M.D.

Perforation of Hollow Viscus: Roentgen Aspects. Edward D. Greenberger. Jour. Oklahoma Med. Assn., **32**, 210–213, June, 1939.

With proper technic, at least 85 per cent of all cases of peptic ulcer perforation can be diagnosed by x-ray examination. Radiographs are made with the patient sitting up or lying on his left side, the x-rays directed perpendicular to the body and the film upright. The voltage and time of exposure are slightly greater than that required for a chest film.

Failure to demonstrate free air in the peritoneal cavity may be due to the fact that there is no air in the stomach, or that it has been prevented from escaping the stomach by spasm at the site of perforation, by adhesions, mucous plugs, fibrin deposits, or adjacent organs, or that, although air has escaped into the abdominal cavity, the radiographic examination has not been complete enough to demonstrate it. The air may lie hidden behind the air in the cardia of the stomach.

The author recommends fluoroscopy of the patient in the sitting-up position since in several cases fluoroscopy showed a small collection of sub-diaphragmatic air not observed on the films. In many cases, also, air was seen on expiration and not on inspiration. The air is sometimes best demonstrated by oblique views.

When the x-ray examination is negative, it may be repeated, from one-half to several hours later, with the patient in the left supine position or, better, in the left supine Trendelenburg position. In this way air can be demonstrated in the abdomen, since these positions cause air trapped in the cardia to pass into the lower end of the stomach and escape through the perforation. If no air is present in the cardia, the patient can swallow some air before this procedure is followed.

It is thus possible to increase the percentage of positive x-ray diagnoses of perforation. Air-containing viscus under the diaphragm and various types of recently induced pneumoperitoneum are the roentgen findings to be differentiated.

JOHN M. MILES, M.D.

Roentgen Therapy of "Ulcer Disease." F. Eggs. Strahlentherapie, **65**, 431, 1939.

The author reports his experience in the treatment of 42 cases of gastric and duodenal ulcer by roentgen rays. Technic as follows: 185 kv., 6 ma., 0.5 mm. Cu, 40 cm. F.S.D., 27 r /min. alternating between two anterior and two posterior fields of 6 × 8 and 8 × 10 cm., respectively, 40 per cent H.E.D. every six days. Two weeks after irradiation of the last posterior area, the same dose is given at intervals of six days over two areas over Th. 5 to 12. With this procedure a combination of local effect and an action on the nerve centers could be studied. Clinical and roentgenological cure lasting one year was seen in 10 patients; there was improvement in 25, and no effect in seven. Since all patients had been treated unsuccessfully for considerable time by other methods before starting x-ray therapy, the author suggests giving x-ray therapy a trial in early cases.

ERNST A. POHLE, M.D., Ph.D.

POLYCYTHEMIA

The Treatment of Polycythemia by Means of General Body Exposure with Roentgen Rays. O. Simon. Strahlentherapie, **65**, 424, 1939.

From 1932 to 1936, the author treated 13 cases of polycythemia with general body exposure to roentgen rays. The technic was: 180 kv., 4 ma., 0.5 mm. Cu, 150 cm. F.S.D., H.V.L. in Cu from 1.0 to 1.5 mm., from 1.2 to 1.35 r/min. in air, daily doses of from 7 to 28 r over anterior and posterior surfaces. The genital organs and eyes were protected by lead rubber. It appeared that the fluctuation of the leukocytes can be used as a guide for radiation therapy. Were they increased, then a drop of from 6,000 to 9,000, or were they

normal to begin with, a drop of from 4,000 to 5,000 indicated that a sufficient dose had been applied. The fluctuations of the erythrocytes could not be used, as an indicator in the treatment. The author believes that general body exposure is superior to exposure of the bone marrow from numerous small fields in the treatment of polycythemia.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Therapy of Polycythemia. L. Siciliano. Strahlentherapie, **65,** 100, 1939.

The technic of roentgen therapy of polycythemia developed by the author belongs somewhere in between the general body exposure and the application of multiple small fields. He uses 160 kv., 4 mm. Al, 3 ma., 70 cm. distance, no diaphragm, focusing on both hips, both legs, and both shoulders alternately. The dose per sitting is 70 r and the total dose distributed over a period of five months is 2,500 r. The response of one case is shown in tabulated form, recording time, red and white blood count, hemoglobin, and dosage. Even with this method the leukocyte count usually does not drop under 3,200.

In summarizing his experience, he states that the major part of the bone marrow should be irradiated but that exposure of the trunk should be avoided. The applied doses must be larger, therefore, than in the true general body exposure. No higher penetration was employed because in the opinion of the author this is unnecessary. He has never observed any severe anemia or hemorrhagic symptoms.

ERNST A. POHLE, M.D., Ph.D.

RADIUM

A New Technic and Dosage System for Gamma-ray Therapy in Surface Application of Radium. Magnus Strandqvist. Acta Radiol., **20,** 1–15, February, 1939.

Strandqvist's new technic and dosage system consists in a standardization of the arrangement of radium in glass applicators of constant size and measurements. The dimensions of the applicators and the number of glass capsules are directly determined by the size of the area to be irradiated. The radiation of each applicator is of a fixed intensity, the value of which has been calculated according to a formula developed by the author. From an "average intensity" derived in this way deductions are made concerning an "average dose," said to possess approximately the same value in gamma therapy as the corresponding "average dose" in x-ray therapy.

ERNST A. SCHMIDT, M.D.

Radium Treatment of Cutaneous Cavernous Hemangiomas, Using Surface Applications of Radium Tubes in Glass Capsules. Magnus Strandqvist. Acta Radiol., **20,** 185–211, April, 1939.

The author discusses his results with a special technic devised by him (radium tubes in glass capsule applicators) in 300 cases of cavernous hemangiomas. The treatment was successful in superficial as well as deep lesions. Cosmetic restoration nearly always followed a single treatment, given during the first three months of life, with a maximum "average dose" of 800 r calculated for 1 cm. superficial tissue layer. Age of patient, size and type of hemangioma, location, and condition of the (covering and surrounding) skin are important factors for dosage and results. As a general rule, no new treatment is given as long as the lesion continues to become smaller and paler; if renewed growth is observed, a new treatment with half the original dosage is given, but, according to Forssell's recommendations, if possible not within a year after the first treatment.

Considering the far superior results of early treatment, radium therapy should be administered, if possible, during the first three months of life. In consideration of other methods of treatment, coagulation by endothermy, CO_2 snow, or something similar, is unfavorable because of its poor cosmetic results; surgery should be reserved for pulsating racemose hemangioma and the capillary types with very low radiosensitivity or for certain types of cavernous hemangioma in the adult.

ERNST A. SCHMIDT, M.D.

Determination of the Effective Dose of Combined Gamma-ray and Neutron Preparations. K. G. Zimmer, H. J. Born, and P. M. Wolf. Strahlentherapie, **65,** 444, 1939.

Lawrence and Lawrence established, in 1936, that fast neutrons are biologically effective. Since it is known that radium or radon preparations mixed with beryllium emit fast neutrons, the authors decided to compare the ionization produced by pure radium and by a mixture of radium plus beryllium. Calculation as well as measurements with a condenser type ionization chamber showed that the increase in ionization due to the presence of neutrons is so small that it would hardly add to the therapeutic value of radium.

ERNST A. POHLE, M.D., Ph.D.

The Surgical Treatment of the Lymphatic Fields in Buccal Carcinoma. F. J. Morrin. Irish Jour. Med. Sci., **160,** 157–163, April, 1939.

In cases of buccal carcinoma, Morrin believes the glands of the neck should be resected because of their accessibility. For the primary lesion, radium is the treatment of choice. No brief is held for irradiation of the glands of the neck because it is believed that irradiation may not be effective and then surgery would be more difficult. However, surgery is contra-indicated in all carcinomas involving the posterior part of the tongue: these should be treated by irradiation.

The author has resected the glands in 50 cases, since 1934, with two immediate deaths. In four cases recurrence occurred in the dissected side of the neck.

The operative procedure is discussed and admitted to be severe, especially since most of the patients are old and debilitated.

J. B. MCANENY, M.D.

The Non-malignant Vascular Tumors of the Parotid Region and Their Treatment by Means of Radium Molds. A. Pagani. Strahlentherapie, **65**, 204, 1939.

During the last eight years the author has observed four children with hemangiomas of the parotid region. They were treated by means of radium molds, administering 0.3 or 0.4 m.c.d. per sq. cm. of surface. Sufficient filtration was used to transmit only gamma rays. Pagani prefers to start therapy when the children are four or five months old; the applicators are left in place three or four hours daily and the entire treatment requires a hospitalization of seven or eight days. This dose may be repeated after three or four months. The results in the cases reported were good. No eye injuries were observed; as a matter of precaution, six or seven mm. of lead were placed around the mold at the upper margin.

ERNST A. POHLE, M.D., Ph.D.

THE SPINE

Two Observations of Posterior Herniation of an Intervertebral Disc. E. Jéquier and J. Rossier. Schweiz. med. Wchnschr., **69**, 273–277, March 25, 1939.

The authors review in considerable detail the literature on the pathogenesis, diagnosis, treatment, and results in nucleus pulposus herniations, and report two cases in which large herniations, proven at operation, produced a complete blockage of the spinal canal to lipiodol.

LEWIS G. JACOBS, M.D.

Fissure Formation in Articular Facets of the Lumbar Spine: Operative Findings in One Case. Herbert E. Hipps. Jour. Bone and Joint Surg., **11**, 289–303, April, 1939.

Hipps presents the first case operated upon with a fissured facet of a lumbar vertebra. The patient had suffered an injury to the lumbar spine with resultant localized tenderness, pain, and parasthesia in the nerve distribution of that segment. Conservative treatment gave no relief, and operation followed with removal of the distal portion of the facet at the fissure line. Restoration to normal followed.

A complete description, both gross and microscopic, is given of the removed specimen. It was composed of a bony center covered with cartilage. The cartilage on the superior surface facing the remainder of the facet closely resembled that cartilage found in a growing epiphysis of a long bone and not that found on a sesamoid bone or an articular surface. The remaining faces of the specimen presented cartilage as found on articular surfaces of other bones.

It is believed that this condition represents simply a failure of a normal-appearing ossification center to fuse. The condition is to be differentiated from a fracture of this process which does occur. This anomaly shows a smooth margin on each side of the fissure and a line of cortical condensation on either side of the fissure line, which is not seen in fracture.

The inherent structural weakness in the anomaly makes it more subject to derangement following injury. The roentgenogram may not show displacement to cause symptoms but these may arise from attempted repair following injury.

J. B. MCANENY, M.D.

The Supine Position in Emergency Treatment of Patients with Fractured Spine. Geoffrey Hyman. British Med. Jour., **1**, 444, 445, March 4, 1939.

The author calls attention to the importance of the manner in which a case of fractured spine is first handled. Reference is made to modern textbooks which deal with the hospital procedure largely, and too briefly with the initial care.

The use of a curved stretcher with the patient in the supine position is recommended. The presence of associated injuries to the head or abdomen is not considered a contra-indication. The ease of handling and transporting the patient is, of course, greatly enhanced by this type of apparatus.

Q. B. CORAY, M.D.

Impressions Gained in Analyzing 10,000 Lumbar Spines. Robert H. Millwee. Texas St. Jour. Med., **34**, 690–694, February, 1939.

Roentgenographs of 10,000 lumbar spines were examined for anomalies and analyzed with regard to age, sex, nationality, and the patient's complaint.

A study of the age groups showed an increase in the detectable anomalies up to maturity and a decrease after age 45, indicating that we may use an x-ray examination to predict longevity. Patients complaining of injury showed twice as many anomalies as those complaining of disease conditions, suggesting that they were more easily injured than were normal individuals.

The female presented sacralization of the fifth lumbar vertebra to a greater extent than the male. The author believes that additional vertebræ have been incorporated into the sacrum as evolution has progressed and that women with more pelvic mobility are more rapidly adding the sixth sacral segment. The same change he finds to a greater extent in those nationalities doing hard physical labor.

A differential diagnosis of spondylolisthesis due to anomaly and due to injury is considered on the basis of the roentgenologic findings and a case reported with autopsy confirmation of a diagnosis of anomaly.

JOHN M. MILES, M.D.